# ADOBE CREEK

## FINAL
## ENVIRONMENTAL IMPACT REPORT

## FOR

## ADOBE CREEK
## CHANNEL IMPROVEMENTS

## Charleston Road to El Camino Real

APRIL 1990

Santa Clara Valley Water District

TC425A36 F4 1990 c.4

## SANTA CLARA VALLEY WATER DISTRICT

# FINAL
# ENVIRONMENTAL IMPACT REPORT
# FOR
# ADOBE CREEK CHANNEL IMPROVEMENTS
# CHARLESTON ROAD TO EL CAMINO REAL

### PROJECT NO. 1010

### SCH NO. 89040420

Report prepared by

DAVID J. POWERS & ASSOCIATES, INC.

Under the Direction of

| | |
|---|---|
| Roy Weese | Associate Civil Engineer |
| Iwao Shintani | Senior Civil Engineer |
| James M. Fiedler | Division Engineer |
| Dr. Bernard H. Goldner | Environmental Specialist |

Ronald R. Esau
General Manager

Stanley N. Williams
Assistant General Manager

APRIL 1990

**DISTRICT BOARD OF DIRECTORS**

| | | | |
|---|---|---|---|
| **Joe Pandit** | **District 1** | **James J. Lenihan** | **District 5** |
| **Patrick J. Ferraro** | **District 2** | **Sig Sanchez, Chairman** | **At Large** |
| **Robert W. Gross, Vice Chairman** | **District 3** | **Joe Judge** | **At Large** |
| **Joseph H. Donohue** | **District 4** | | |

# PREFACE

This Environmental Impact Report (EIR) has been prepared to address the U-frame (vertical wall) channel improvements proposed along the Adobe Creek between Charleston Road and El Camino Real. A Negative Declaration was adopted in 1985 as part of a larger flood control project extending along Adobe Creek between Palo Alto Flood Basin and El Camino Real. This EIR represents a subsequent phase of environmental review which addresses modifications to the channel design now being proposed between Charleston Road and El Camino Real. These modifications were formulated and proposed after it was determined that the previously adopted 1985 design was not feasible.

The approved 1985 Adobe Creek Planning Study proposed to reconstruct the existing concrete trapezoidal channel by adding a 2.5 foot (maximum height) floodwall to the 2,000 feet of channel upstream of Charleston Road, replacing the next 1,400 feet of trapezoidal concrete channel with a deeper trapezoidal channel with 2 foot (maximum height) floodwalls, and replacing the Alma Street bridge and Southern Pacific culvert. It was determined in 1988 that this approved channel design would require floodwalls substantially higher than 2.5 feet or a channel significantly wider than the existing channel in order to accommodate the 100-year flood flow. Although the wider channel could be accommodated within the existing right-of-way, adjacent property owners would be significantly affected by the loss of yard space, landscaping, and improvements. In order to avoid widening the channel and affecting adjacent properties, the Santa Clara Valley Water District began studying possible channel design alternatives. During this period, the SCVWD staff also held community meetings with the affected neighbors to explain the channel modifications being considered. After studying possible channel designs, the SCVWD proposed a U-frame channel. This design was selected because it minimized channel widening, limited channel wall height to a maximum of five feet (above ground) at any location, and avoided replacement of the Alma Street bridge.

This EIR address the proposed U-frame channel along Adobe Creek and considers the impacts of several other alternatives to the project, including upstream storage in reservoirs, a bypass located in Charleston Road and Alma Street, and diversion to the Matadero Creek drainage area.

# SUMMARY

The Santa Clara Valley Water District is proposing to replace and enlarge approximately 3,100 feet of the existing Adobe Creek channel, located along Adobe Creek between Charleston Road and 800 feet upstream of Alma Street in Palo Alto. The existing concrete trapezoidal channel would be removed and replaced with a concrete U-frame (vertical wall) channel. The proposed U-frame channel would be 20 feet wide from Charleston Road to approximately 1,500 feet upstream. The U-frame channel would transition to a width of 17 feet for the remaining approximately 1,600 feet. The proposed channel depth would be approximately 11 to 13 feet. Proposed floodwall heights would be five feet or less above the adjacent ground surface. Proposed channel improvements would also include reconstruction of the Southern Pacific railroad culvert, modification of the Alma Street bridge, and replacement of the pedestrian footbridge between Duncan Place and Creekside Drive, and the installation of an access ramp at Miller Avenue. These improvements are proposed to eliminate existing flooding hazards along Adobe Creek.

| IMPACTS | MITIGATION |
|---|---|
| **Construction Impacts** | |
| Vibrations and ground settlement resulting from construction of the project could potentially damage houses and other structures located along the creek channel. **(Significant Impact)** | The project proposes to take measures to protect homes and structures from potential damage. In addition, the project would repair structures damaged by channel construction. **(Significant, Unavoidable Impact)** |
| Construction of the project would result in significant short-term noise impacts on surrounding residences. **(Significant Impact)** | Noise impacts could be mitigated by controlling noise in the project area. The following mitigation measures would be implemented: 1) the construction of temporary plywood walls to shield residences along the creek channel, and 2) the use of alternative less noisy construction equipment where possible. **(Significant, Unavoidable Impact)** |
| Construction of the project would result in short-term air quality (dust) impacts in the surrounding area. **(Significant Impact)** | The construction area should be watered and swept as necessary to reduce dust in the project area. **(Nonsignificant Impact with Mitigation)** |
| Temporary removal of the existing footbridge between Duncan Place and Creekside Drive would result in short-term impacts to bicycle and pedestrian traffic. **(Nonsignificant Impact)** | The project proposes to limit the duration of footbridge inaccessibility to 2-4 months. |

| IMPACTS | MITIGATIONS |
|---|---|
| **Construction Impacts (cont.)** | |
| The removal of existing fencing and installation of temporary fencing along backyards adjacent to the creek channel would result in impacts to privacy and security. **(Nonsignificant Impact)** | The project proposes to construct temporary construction fencing around backyards, and to replace all fences that are temporarily removed. |
| The temporary relocation of the Southern Pacific railroad line closer to Alma Street would result in noise impacts and headlamp glare (into oncoming traffic on Alma Street). **(Nonsignificant Impact)** | The project would install a glare screen for a few hundred feet along Alma Street to reduce glare from the train headlamp. No mitigation for potential noise impacts is proposed. |
| Construction of the new creek channel would require the relocation of public utility poles and private underground utilities located in adjacent backyards. **(Nonsignificant Impact)** | The project proposes to relocate all utilities as required. Any damages that occur would be repaired by the project. |
| The access of construction vehicles into the creek channel from Alma Street and Charleston Road would result in short-term traffic impacts on these streets. Construction of the new railroad bridge would have short-term impacts upon traffic on Alma Street. **(Significant Impact)** | Traffic impacts would be mitigated by maintaining one lane open in each direction during construction, and limiting impacts to off-peak hours where possible. **(Nonsignificant Impact with Mitigation)** |
| **Public Safety** | |
| The vertical side walls of the proposed U-frame channel would present greater public safety hazards than the existing trapezoidal channel. **(Nonsignificant Impact)** | The project is proposing to construct steel ladders periodically along the proposed channel to facilitate easy escape. |

| IMPACTS | MITIGATIONS |
|---|---|
| **Geology** | |
| The proposed project would be subject to severe ground shaking in the event of an earthquake. **(Significant Impact)** | Seismic hazards would be reduced by designing the proposed creek channel to withstand the lateral pressures resulting from the maximum expected ground acceleration at the project location. **(Nonsignificant Impact with Mitigation)** |
| **Vegetation and Wildlife** | |
| Construction of the project would result in the removal of trees and other vegetation located above the creek channel and in adjacent backyards. **(Nonsignificant Impact)** | The project proposes to provide monetary compensation for all removed vegetation, based upon its appraised value. |
| **Visual** | |
| Visual impacts would result from the construction of channel walls up to approximately five feet in height and from the removal of trees and shrubs. **(Significant Impact)** | The visual impacts of the proposed floodwalls would be reduced by the construction of screening fencing and the monetary compensation for removed vegetation. **(Significant, Unavoidable Impact)** |
| Construction of a higher footbridge would result in privacy impacts to the four properties located adjacent to the bridge. **(Nonsignificant Impact)** | This impact would be mitigated by constructing a screening fence along the footbridge of an adequate height to screen views. |
| **Cultural Resources** | |
| The project would result in potential impacts to cultural resources located on the site. **(Significant Impact)** | Project impacts to cultural resources would be reduced by the monitoring of construction activities by a qualified archaeologist and/or Native American representative. Any cultural resources encountered would be documented and preserved. **(Significant, Unavoidable Impact)** |

## SUMMARY OF ALTERNATIVES

The SCVWD analyzed several flood control alternatives in addition to the proposed project. These alternatives are referred to as follows: 1) No Project, 2) Floodwalls/17 Foot U-frame, 3) Bypass, 4) Upstream Storage, 5) Adobe Creek Diversion. A brief description of these alternatives and their impacts is contained below.

1. **No Project** The No Project alternative consists of maintaining the existing concrete trapezoidal channel, without the construction of any channel improvements upstream of Charleston Road. The No Project alternative would perpetuate the existing flood hazards of Adobe Creek.

   The No Project alternative would result in greater environmental impacts than the proposed project.

2. **Floodwalls/17 Foot U-Frame** This alternative consists of constructing floodwalls to a maximum of 9.2 feet high along the top of the banks of the existing trapezoidal channel from Charleston Road to a point approximately 1,600 feet upstream. A 17 foot wide U-frame channel would replace the existing trapezoidal channel along the remaining approximately 1,500 feet. This alternative would also include replacement of the Southern Pacific (SP) railroad culvert and modifications of the Alma Street bridge.

   This alternative would result in similar construction impacts to the proposed project, but would have greater visual impacts due to the approximately nine foot floodwalls along the backyards of adjacent properties. In addition, this alternative would create an unstable water surface within the channel. This alternative would have greater environmental impacts than the proposed project.

3. **Bypass** This alternative consists of the construction of a bypass between the SP railroad tracks and Charleston Road, with sufficient capacity to eliminate the need for improvements to this section of the Adobe Creek channel. The bypass structure would consist of an underground box culvert along Alma Street and Charleston Road.

   This alternative would result in significant impacts to traffic circulation, access to adjacent homes on Charleston Road, relocation of utilities, reconstruction of the Charleston Road bridge, and acquisition of additional right-of-way. Therefore, this alternative would have substantially greater environmental impacts than the proposed project.

4. **Upstream Storage** This alternative consists of constructing an upstream reservoir to detain peak storm flows in order to reduce the extent of the proposed Adobe Creek channel improvements. Four possible upstream storage sites were identified: 1) Hidden Villa, 2) Foothill College, 3) Alta Mesa Cemetery, and 4) Terman Junior High. None of the storage sites would have adequate capacity to fully reduce the flows within the existing Adobe Creek channel. Therefore, lower floodwalls along Adobe Creek between Alma Street and Charleston Road would be required under any of the four possible upstream storage site scenarios.

   The upstream storage alternative would significantly impact the four storage (reservoir) sites. Construction of a reservoir on any of these sites would result in significant impacts to riparian habitat and existing land use. The channel improvements between Charleston

Road and Alma Street would result in similar construction impacts as the proposed project. The upstream storage alternative would result in substantially greater environmental impacts than the proposed project.

5. **Adobe Creek Diversion** This alternative consists of diverting a portion of the stormflows from Adobe Creek to Matadero Creek in order to limit flood control improvements on Adobe Creek between Alma Street and Charleston Road to floodwalls only. This alternative would require improvements to an extensive portion of the flood control channel.

   The Adobe Creek Diversion alternative would result in construction impacts similar to the proposed project from Charleston Road to Alma Street. This alternative would also create construction impacts along much of the extensive diversion channel alignment. In addition, this alternative would impact riparian vegetation, (by replacing earthen channel with concrete lining), increase turbidity in Adobe Creek, eliminate channel accesses, impact traffic, and possibly expose workers and residents to contaminated groundwater or soils. The Diversion alternative would have substantially greater environmental impacts than the proposed project.

## AREAS OF PUBLIC CONTROVERSY

Several areas of public concern were identified during a series of public meetings conducted between the Santa Clara Valley Water District and the local community. The primary issues of concern identified at these meetings are as follows:

| | |
|---|---|
| Construction | Impacts of construction activities upon surrounding residences, including noise and dust, loss of backyard vegetation, possible damage to private structures (pools, patios, sheds, etc.) caused by construction, loss of privacy and security/safety during backyard fence removal and reconstruction, disturbance to pets, and impacts to bicycle and pedestrian traffic (during footbridge removal and replacement). |
| Visual | Visual impacts of project resulting from construction of higher channel walls behind residential backyards (above adjacent ground surface) and removal of backyard vegetation. |
| Hydrology | Hydrological analysis used to develop proposed project; proposed and existing channel capacities; cause of flooding in area; flooding caused by upstream development. |
| Alternatives | Criteria used for analyzing possible project alternatives; criteria and rationale for chosing proposed project; potential need for additional future widening of the project portion of the Adobe Creek channel. |

# TABLE OF CONTENTS

PAGE

PREFACE i

SUMMARY ii

SUMMARY OF ALTERNATIVES v

AREAS OF PUBLIC CONTROVERSY vi

I. DESCRIPTION OF PROPOSED PROJECT 1

- A. LOCATION AND OVERVIEW 1
- B. BACKGROUND
- C. PHYSICAL CHARACTERISTICS 4
- D. PROJECT OBJECTIVES 4
- E. PROJECT CONSISTENCY WITH PLANS, GOALS AND POLICIES 10
- F. USES OF THE EIR 11
- G. COMMUNITY INVOLVEMENT 11

II. ENVIRONMENTAL SETTING, IMPACTS AND MITIGATION MEASURES 12

- A. CONSTRUCTION IMPACTS 12
  - 1. Setting 12
  - 2. Impacts 14
  - 3. Mitigation 23
- B. PUBLIC SAFETY 26
  - 1. Setting 26
  - 2. Impacts 26
  - 3. Mitigation 26
- C. GEOLOGY 27
  - 1. Setting 27
  - 2. Impacts 27
  - 3. Mitigation 27
- D. VEGETATION AND WILDLIFE 28
  - 1. Setting 28
  - 2. Impacts 31
  - 3. Mitigation 31
- E. VISUAL 31
  - 1. Setting 31
  - 2. Impacts 32
  - 3. Mitigation 32
- F. CULTURAL RESOURCES 39
  - 1. Setting 39
  - 2. Impacts 39
  - 3. Mitigation 39

PAGE

III. ALTERNATIVES TO THE PROPOSED PROJECT 40

- A. No Project 40
- B. Floodwalls with 17 Foot U-Frame 40
- C. Adobe Creek Bypass 43
- D. Upstream Storage 48
- E. Adobe Creek Diversion 54
- F. Other Alternatives 61

IV. ANY SIGNIFICANT ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED IF THE PROPOSED PROJECT IS IMPLEMENTED 64

V. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 64

VI. ANY IRREVERSIBLE ENVIRONMENTAL CHANGES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED 65

VII. GROWTH INDUCING IMPACT OF THE PROPOSED PROJECT 65

VIII. EFFECTS FOUND NOT TO BE SIGNIFICANT 65

IX. EIR AUTHORS AND CONSULTANTS 67

X. REFERENCES 68

APPENDICES:

APPENDIX A DESCRIPTION OF ONE PERCENT FLOOD
APPENDIX B HYDROLOGY REPORT
APPENDIX C GEOTECHNICAL ASSESSMENT
APPENDIX D NOISE AND AIR QUALITY ASSESSMENTS
APPENDIX E ALTERNATIVES ANALYSIS/ SUPPLEMENT TO ALTERNATIVES ANALYSIS
APPENDIX F AMENDMENT TO THE DRAFT EIR

# TABLE OF EXHIBITS

PAGE

## FIGURES

Figure 1 Regional Map/Adobe Creek Watershed 2
Figure 2 Vicinity Map 3
Figure 3 Location of Proposed Channel Improvements 5
Figure 4 Typical Channel Configuration 6
Figure 5 Cross-Sections of Proposed U-Frame Channel 8
Figure 6 Bridge Modifications at Alma Street 8
Figure 7 Bridge Modifications at Southern Pacific Railroad Crossing 9
Figure 8 Aerial Photograph 14
Figure 9 Typical Temporary Shoring and Bracing Systems 15
Figure 10 Potential Ground Movement 17
Figure 11 Location of Adobe Creek Bypass Alternative 44
Figure 12 Typical Cross-Sections During Construction - Charleston Road 45
Figure 13 Typical Cross-Sections During Construction - Along Alma Street from Adobe Creek to Charleston Road 46
Figure 14 Possible Reservoir Sites for Upstream Storage Alternative - Hidden Villa and Foothill College 49
Figure 15 Possible Reservoir Sites for Upstream Storage Alternative - Alta Mesa Cemetary and Terman Junior High 50
Figure 16 Location of Upstream Diversion Alternative 55

## TABLES

Table 1 Potentially Impacted Houses 19
Table 2 Potentially Impacted Structures 20
Table 3 Potentially Impacted Trees 29
Table 4 Proposed Channel Wall Heights 37
Table 5 Comparision of Project Alternative Impacts 41

# SECTION I

## DESCRIPTION OF THE PROPOSED PROJECT

### A. LOCATION AND OVERVIEW

The proposed project is located along the Adobe Creek channel in the southerly portion of the City of Palo Alto near the City of Mountain View border, as shown in Figure 1. The project portion of the creek extends along approximately 3,100 feet of Adobe Creek, from Charleston Road to approximately 800 feet upstream of Alma Street (refer to Figure 2).

The Santa Clara Valley Water District (SCVWD) is proposing the construction of improvements to the Adobe Creek channel from the Palo Alto Flood Basin to El Camino Real to increase channel capacity to provide for the one percent design flood protection[1]. The improvements between the Palo Alto Flood Basin upstream to Charleston Road have been recently completed. Improvements to the project portion of the channel, between Charleston Road and 800 feet upstream of Alma Street, consist of the removal and replacement of the existing trapezoidal concrete channel with a U-frame concrete channel. The project also includes modification of the Alma Street bridge and the Southern Pacific (SP) railroad culvert, and the installation of an access ramp at Miller Avenue.

### B. BACKGROUND

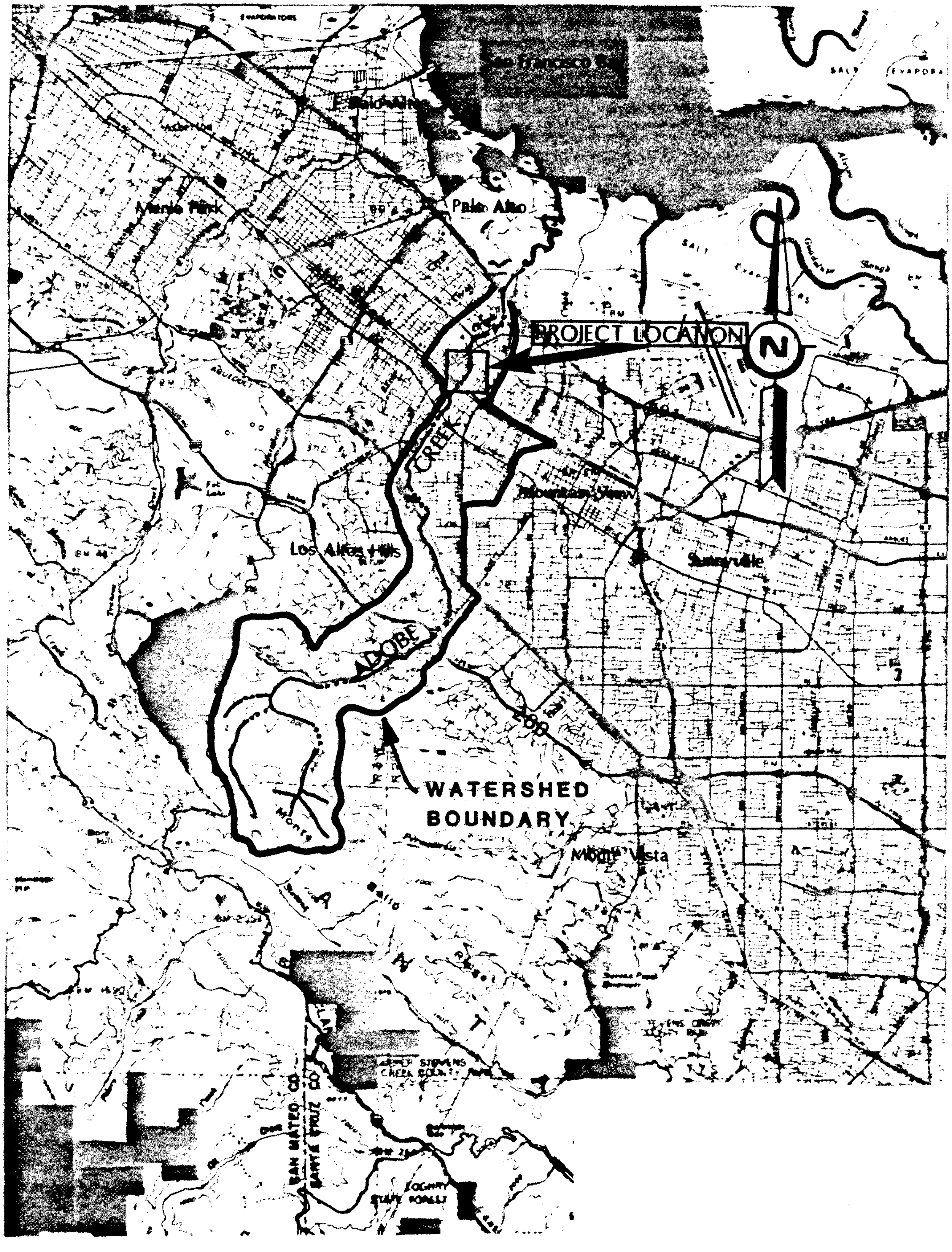
Adobe Creek originates in the northeasterly slopes of the Santa Cruz Mountains near Monte Bello Ridge. The creek flows through Los Altos, Mountain View, and Palo Alto, and ultimately flows into the Palo Alto Flood Basin northeast of U.S. 101. The total watershed area of the Adobe Creek is approximately 10 square miles (refer to Figure 1).

Adobe Creek has a history of flooding in the Cities of Palo Alto, Los Altos, and Mountain View. In the project vicinity, Adobe Creek continues to be a source of potential flood hazards. The existing channel between Charleston Road and Alma Street does not have the capacity to safely carry the one percent design flows (only 1,200 cubic feet per second versus the one percent design flow of 3,100 cfs). In addition, the SP culvert only carries one-third of the one percent design flows. Creek overflows at the SP culvert have resulted in flooding of the areas upstream and downstream of the SP railroad culvert, and continue to present potential flooding hazards to this area.

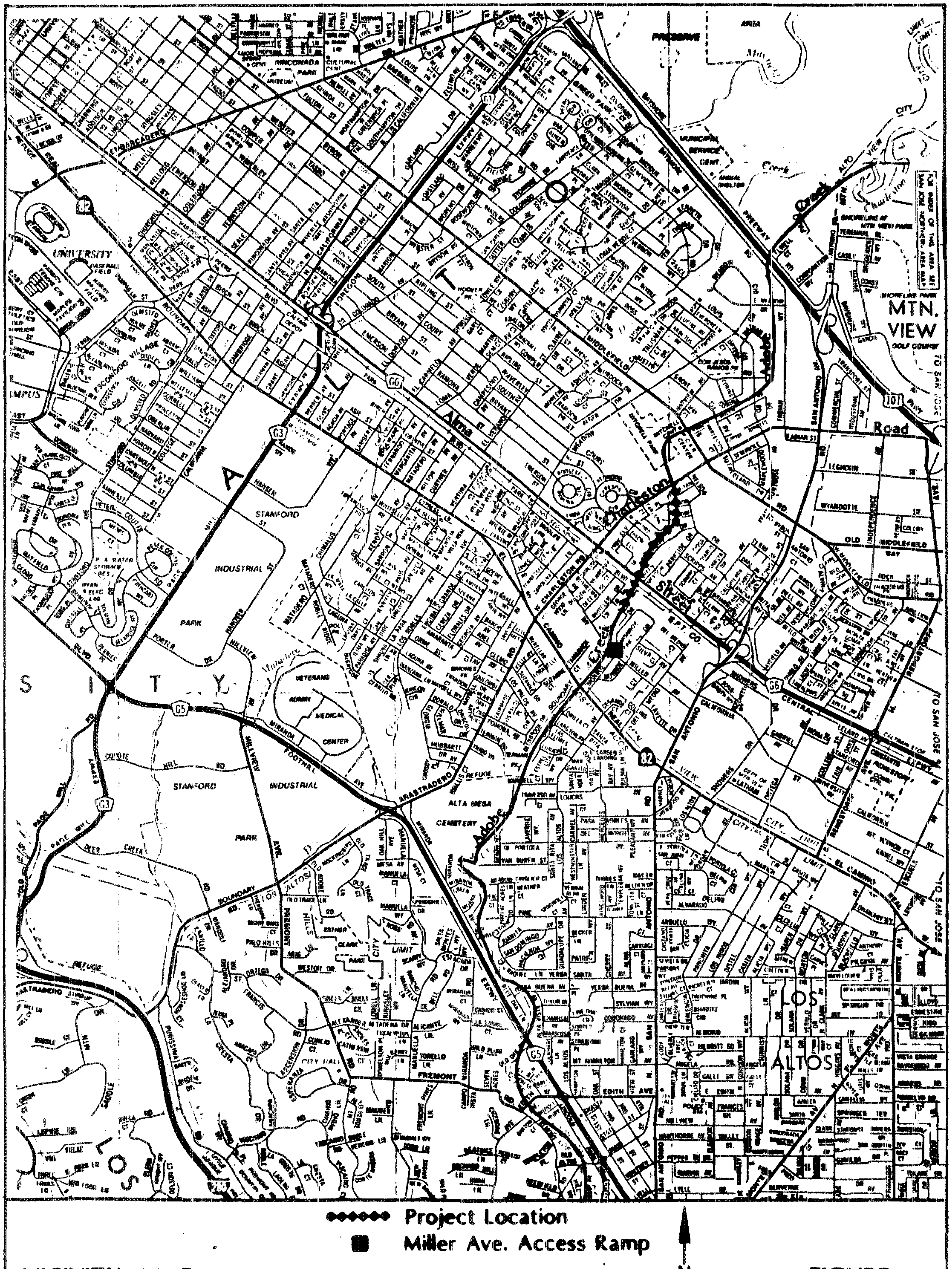
In response to the flooding hazards on Adobe Creek, the SCVWD has constructed channel improvements to the creek between the Palo Alto Flood Basin upstream to Charleston Road. The proposed improvements to the Adobe Creek channel between Charleston Road to upstream of Alma Street are designed to accommodate flows from the 100-year flood event to provide the necessary flood protection for the surrounding residences and businesses.

---

[1] The one percent flood is the flow of water from a drainage area that, on the average and over a long period of time, has a one percent chance of occurring or being exceeded during any given year. Refer to Appendix A for full description.



ADOBE CREEK WATERSHED/REGIONAL LOCATION FIGURE 1



●●●●●● Project Location

■ Miller Ave. Access Ramp

VICINITY MAP

One inch equals 2800 feet

N

FIGURE 2

## C. PHYSICAL CHARACTERISTICS

The SCVWD proposes to replace 3,100 feet of the existing concrete lined Adobe Creek Channel with a larger capacity channel. The channel improvements would extend along Adobe Creek from Charleston Road in a southerly direction to a point approximately 800 feet upstream of Alma Street as shown on Figure 3. As shown on Figure 3, the project would also install an access ramp into the channel at Miller Avenue. The existing concrete trapezoidal channel lining would be removed and replaced with a U-frame channel as illustrated on Figure 4. The existing channel capacity for this portion of Adobe Creek is approximately 1,200 cfs with no allowance for freeboard[2]. The design capacity after proposed improvements would be 3,100 cfs with freeboard. The SCVWD also proposes to improve or replace the SP culvert, the bridge at Alma Street, and the pedestrian footbridge between Duncan Place and Creekside Drive along the project reach of the channel.

The proposed U-frame channel would be 20 feet wide from Charleston Road to approximately 1,500 feet upstream as shown on the top of Figure 5 (Segment 1). The U-frame channel would then transition to a width of 17 feet for the remaining approximately 1,600 feet, as shown on the bottom of Figure 5 (Segment 2). Proposed channel depth would be approximately 11 to 13 feet. Proposed channel wall heights would be five feet or less above the adjacent ground surface.

Typical channel reconstruction could proceed as follows. Construction of the channel would begin with the removal of vegetation, fences and other structures along the channel as required for construction, and the installation of a temporary construction fence. A shoring system would be installed to stabilize the bank and adjacent ground during channel construction. This shoring system could consist of sheet piles or soldier piles with lagging. The existing concrete channel lining would be removed and the new channel excavated. The new concrete channel bottom would be poured followed by forming and pouring the new channel walls. After completion of the new channel, backfill would be placed behind the channel walls to level the ground surface. Construction fencing would be removed and any damages to the adjacent backyards would be repaired or compensated for monetarily.

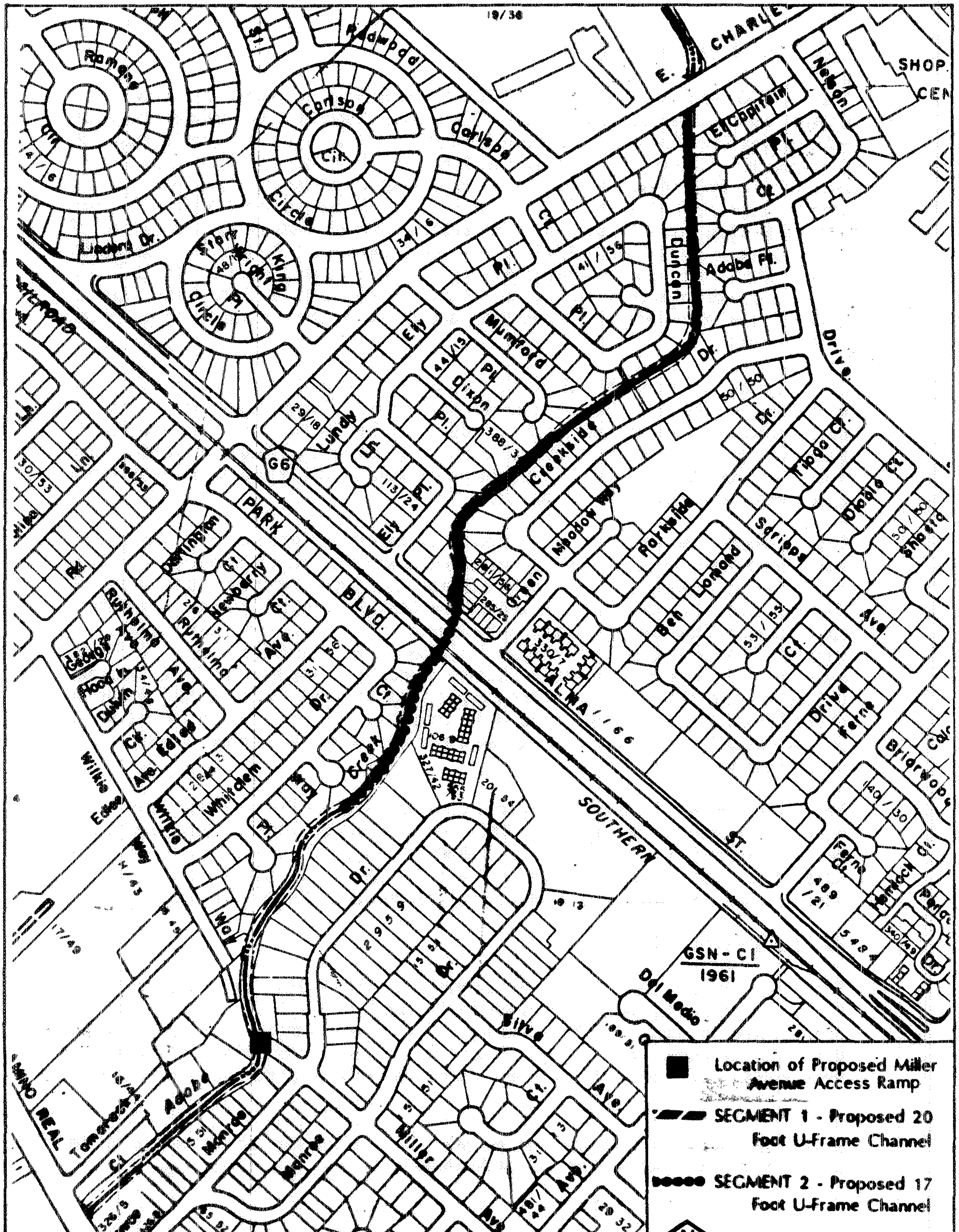
The existing pedestrian footbridge extending between Duncan Place and Creekside Drive would be removed and reconstructed. The channel bottom beneath the Alma Street bridge would be lowered and reconstructed as illustrated in Figure 6. The SP culvert would be removed and reconstructed as shown on Figure 7. The existing railroad tracks would be relocated onto a new section of culvert during construction of the new culvert.

## D. PROJECT OBJECTIVES

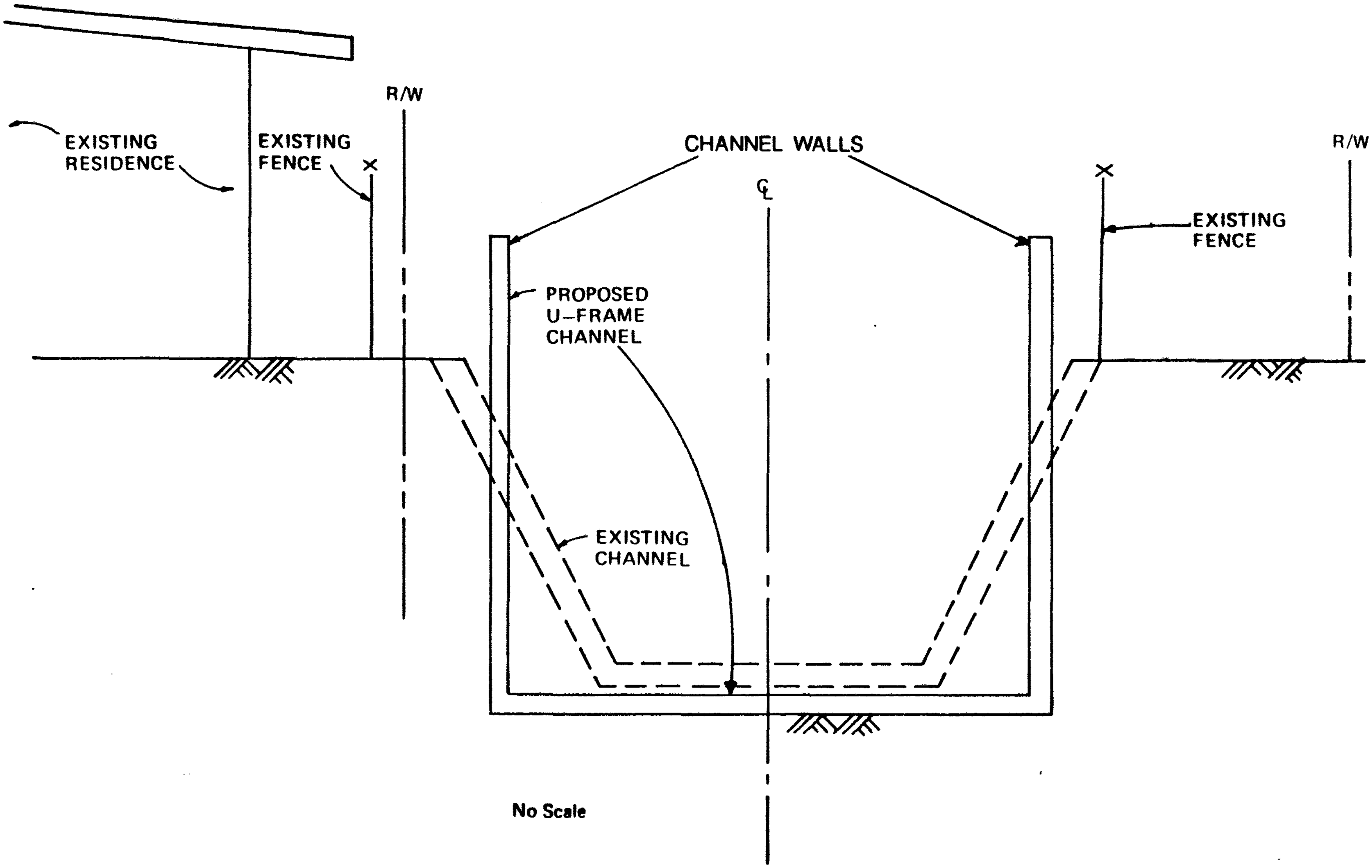
The primary objective of the proposed project is to provide flood protection against the 100-year flood by increasing the existing creek channel capacity. It is also the objective of the project to accomplish the following: 1) to provide a stable water surface profile that would not impact local drainage; 2) to minimize channel wall heights (below existing fences); and 3) to minimize intrusion into the existing adjacent properties. The proposed

---

[2] "Freeboard" refers to the reserve capacity in the creek channel which helps prevent overtopping (that may result from unanticipated water movement within the channel).

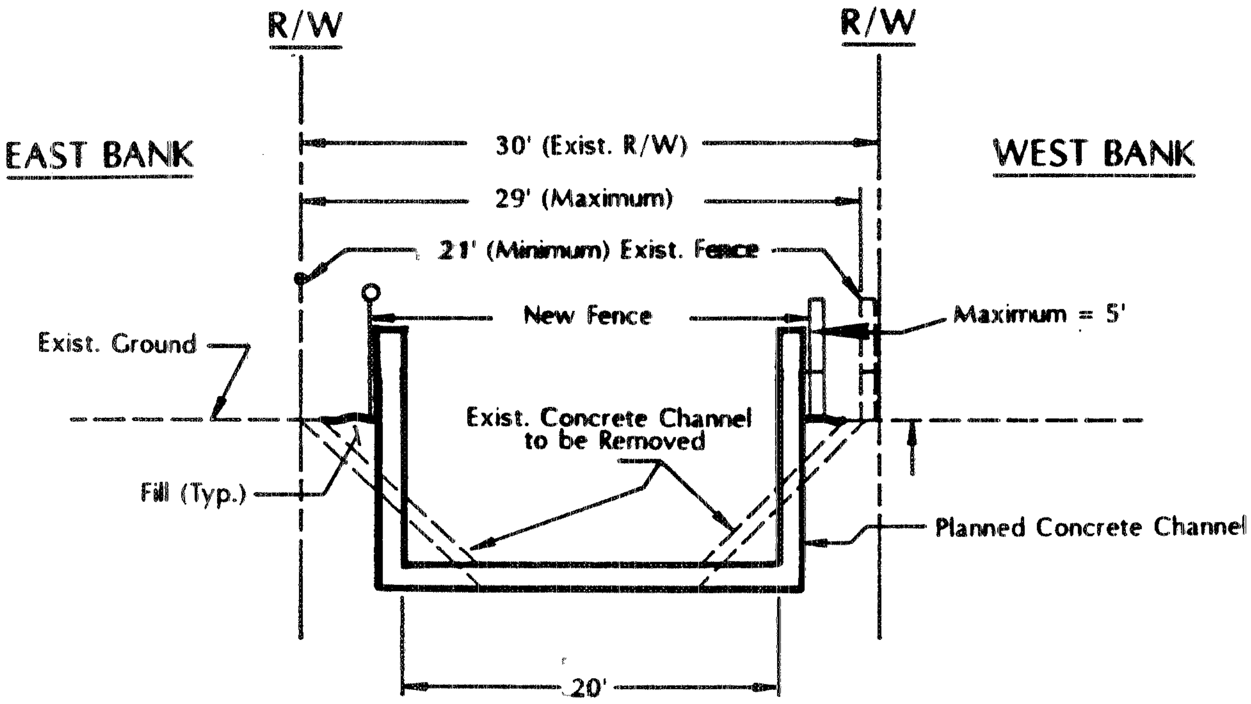


LOCATION OF PROPOSED CHANNEL IMPROVEMENTS FIGURE 3

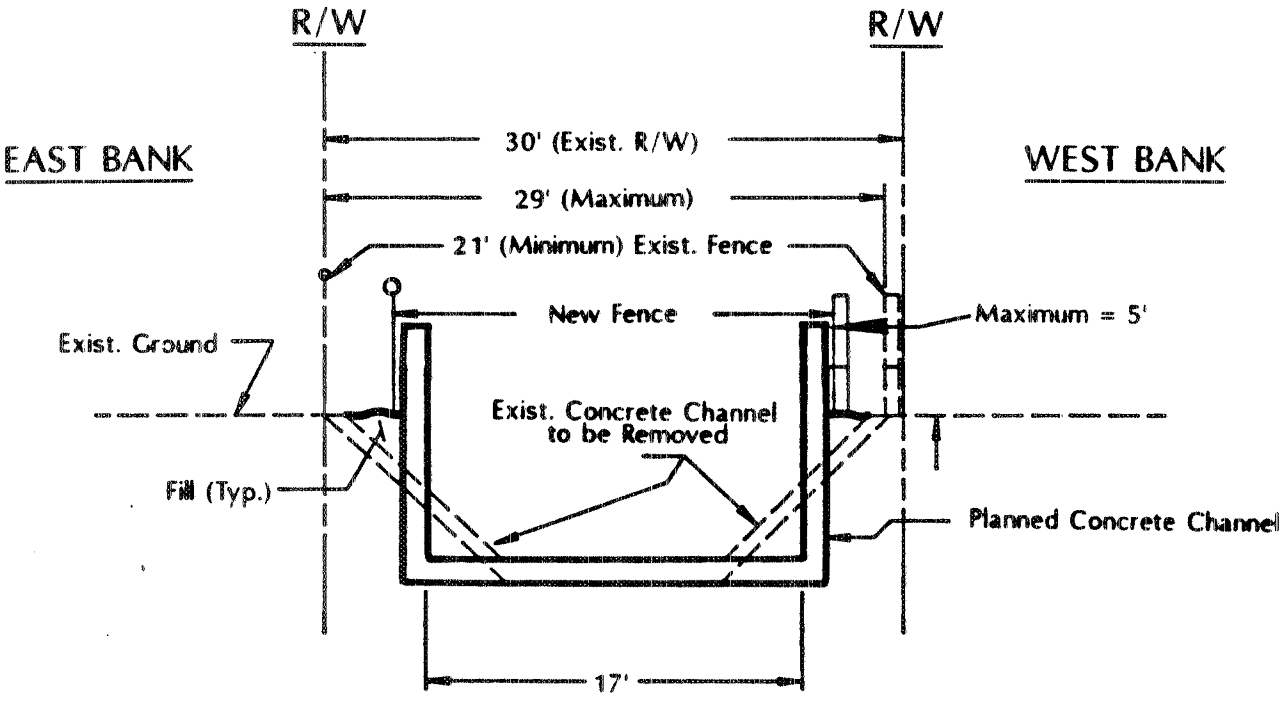


TYPICAL CHANNEL CONFIGURATION (LOOKING UPSTREAM)

FIGURE 4



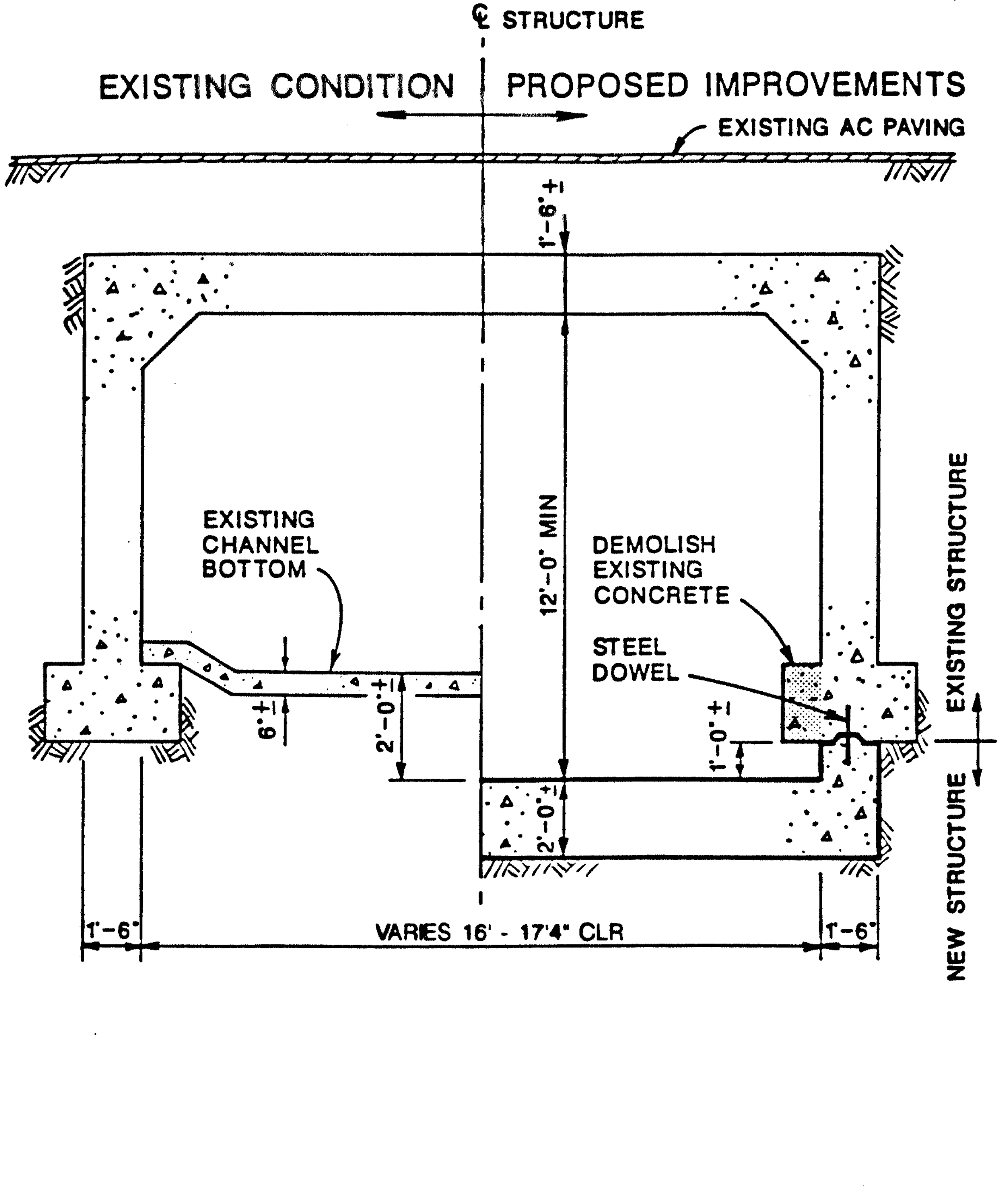
From Charleston Road to 1500 Feet Upstream



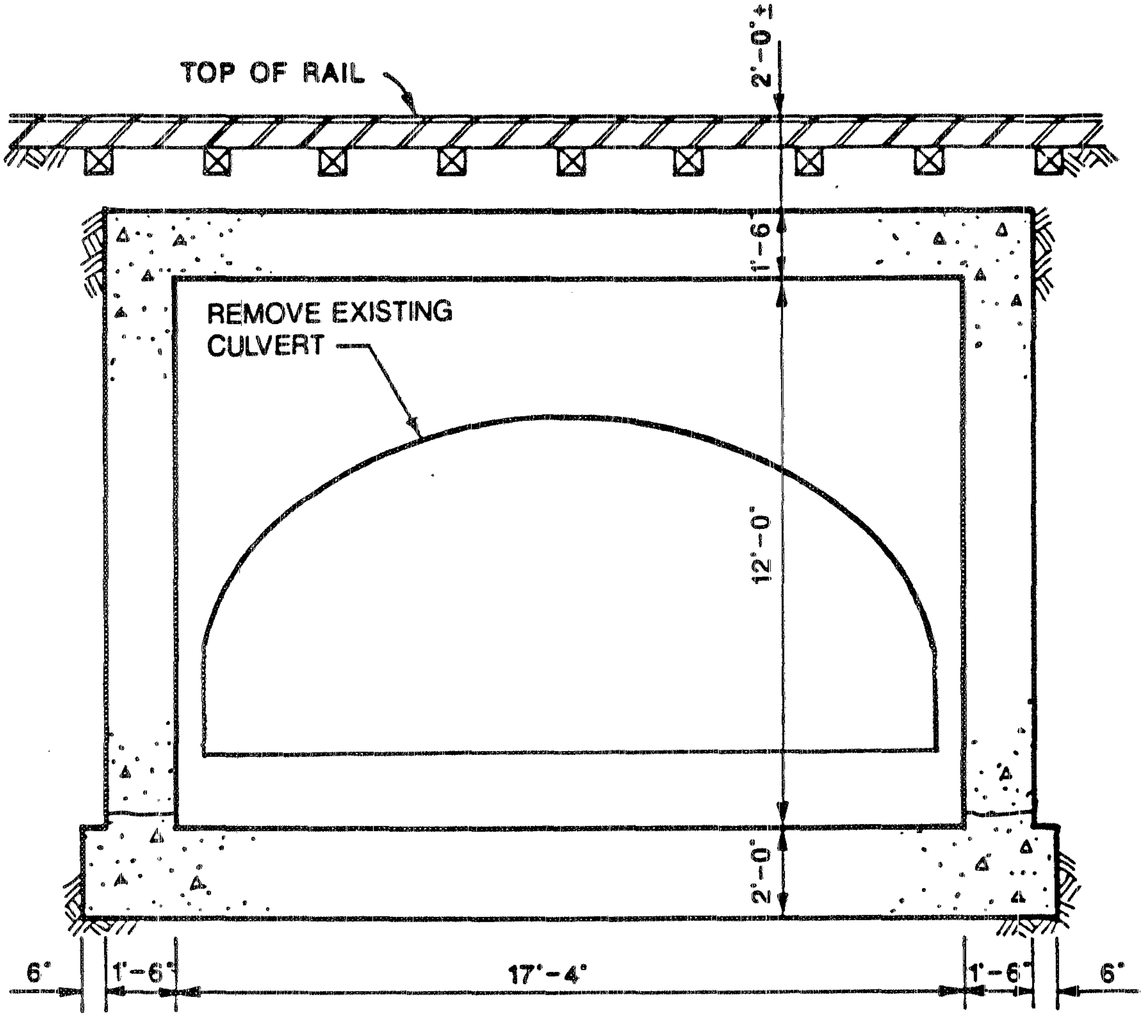
From 1500 Feet to 3100 Feet Upstream of Charleston Road

CROSS-SECTIONS OF PROPOSED U-FRAME CHANNEL
(LOOKING UPSTREAM)

FIGURE 5



BRIDGE MODIFICATIONS AT ALMA STREET FIGURE 6



CULVERT REPLACEMENT AT SOUTHERN PACIFIC RAILROAD CROSSING

FIGURE 7

project would complete the 100-year flood protection along the Adobe Creek channel between Palo Alto Flood Basin and El Camino Real.

## E. CONSISTENCY WITH PLANS, GOALS AND POLICIES

### 1. PALO ALTO COMPREHENSIVE PLAN (GENERAL PLAN)

Palo Alto's Comprehensive Plan is the principal planning document for the City of Palo Alto, which provides the planning guidelines for all development within the City.

#### Environmental Resources Policies

Environmental Resources Policies #1 and #2, Program 2 calls for the replanting of vegetation where it has been removed. **Consistency:** The project is providing compensation for the replacement of removed vegetation and is, thus, consistent with this program. In addition, the project would comply with the City of Palo Alto Tree Ordinance, where applicable.

Environmental Resources Policies #1 and #2, Program 4 calls for participation in the required National Flood Insurance Protection Program, with implementation of floodplain protection such as channels and retention basins. **Consistency:** The project is proposing the Adobe Creek channel improvements to reduce the existing flood potential (based upon Federal Emergency Management Agency criteria) in this area of the City and is, thus, consistent with this policy.

Environmental Resources Policy #10, Program 35 calls for the analysis of noise impacts of new projects. **Consistency:** The noise impacts of the project are analyzed in this EIR and mitigation measures are identified.

Environmental Resources Policy #13 calls for the mitigation of air quality impacts of developments. **Consistency:** The project is proposing mitigation measures to control dust in the area of construction and is thus consistent with this policy.

Environmental Resources Seismic Hazards Policies call for a reduction of the potential hazards from seismic activity. **Consistency:** The project is proposing a channel design to reduce the potential for structural damage caused by an earthquake.

#### Noise Ordinance

The City's Noise Ordinance provides that "no individual piece of (construction ) equipment shall produce a noise level exceeding 110 dBA at a distance of 25 feet," and that "the (total construction) noise level at any point outside of the property plane for the project shall not exceed 100 dBA." The ordinance limits the hours of construction to 8AM-8PM on weekdays, 9AM-8PM on Saturdays, and 10AM-6PM on Sundays. **Consistency:** The SCVWD noise regulations imposed on the building contractor require that all construction activities are in accordance with the City's Noise Ordinance. The SCVWD may need to request a variance for the use of construction equipment which exceeds these limits.

## F. USES OF THE EIR

This Environmental Impact Report (EIR) will be used to provide the environmental review necessary for Santa Clara Valley Water District approvals to construct the proposed project. The project may require a variance approval from the City of Palo Alto for loud construction equipment. The project may require permits from the City of Palo Alto for modification of the Alma Street bridge and construction access onto the site from City streets. The project will require permits from the City of Mountain View for replacement of a storm drain. The project will also require a stream alteration agreement from the Department of Fish and Game, and a Section 404 permit from the U.S. Army Corps of Engineers. It is the intent of this EIR to provide the SCVWD Board of Directors as well as the appropriate agencies and general public with the relevant environmental information to use in determining the approval or denial of the proposed project.

## G. COMMUNITY INVOLVEMENT

In October, 1988, the Santa Clara Valley Water District began conducting a series of meetings to inform the local community of the proposed flood control improvements along Adobe Creek upstream of Charleston Road and the considered alternatives. During these meetings, SCVWD received comments and answered questions from the community regarding project planning, construction, and alternative criteria. The community also expressed the need for more focussed exploration of the technical and enviromental issues of the proposed project. A liaison committee consisting of both SCVWD staff and community members was formed in April, 1989 to discuss in more detail issues including hydrology, construction impacts, and project alternatives. The issues and concerns raised during the meetings between the District and the local community have been addressed in this EIR.

# SECTION II

# ENVIRONMENTAL SETTING, PROJECT IMPACTS AND MITIGATION MEASURES

## A. CONSTRUCTION IMPACTS

### 1. Setting

#### Overview of the Project Area

Adobe Creek is located in the northwest portion of Santa Clara County, originating in the northeasterly slopes of the Santa Cruz Mountains and flowing northerly through Los Altos, Mountain View and Palo Alto (refer to Figure 1). Adobe Creek ultimately drains into the Palo Alto Flood Basin, just northeast of U.S. Highway 101.

Most of the project portion of the Adobe Creek channel flows through the City of Palo Alto, roughly between Charleston Road and Alma Street. A short reach of the proposed channel improvements upstream of Alma Street is located both within the City of Mountain View and the City of Palo Alto. The existing Adobe Creek channel was constructed around the time that the adjacent residential uses were developed in the vicinity of the project.

The existing concrete lined channel in the vicinity of the project was originally constructed in 1957 and 1958. The SP railroad culvert was constructed in 1926, and the Alma Street bridge was constructed in 1923 and 1957. Neither of these bridges has been improved to increase its waterway capacity since original construction. The project site is surrounded by a residential subdivision which was built in the mid 1950's. Prior to that time, the area consisted primarily of agricultural land and floodplain.

#### Existing Land Use of the Project Site and Surrounding Area

An aerial photograph showing the project area is presented on Figure 8. The area surrounding the project site consists mostly of single family homes, with lots approximately 5,000 square feet in size. Two multiple family developments are located adjacent to the project, along the eastern side of the creek channel (refer to Figure 8).

A bridge crosses Adobe Creek in the southern portion of the project site at Alma Street. The Southern Pacific railroad tracks cross Adobe Creek approximately 40 feet upstream of the Alma Street bridge.

The existing channel right-of-way along the project reach of the creek varies from 30 feet wide (below Alma Street) to 50 feet wide (above Alma Street). The creek channel is lined on both sides with the backyards of single family residences. In some areas (primarily on the west bank between Charleston Road and Alma Street), residential development including swimming pools, decks, and other structures encroaches into the District right-of-way. The distance across the creek channel between fences is less than 25 feet at some locations (21 feet minimum).

## 2. Impacts

A portion of the construction impacts description is based upon a geotechnical/construction impact assessment conducted for the project site by CH2M Hill. This report is contained in Appendix C of this EIR.

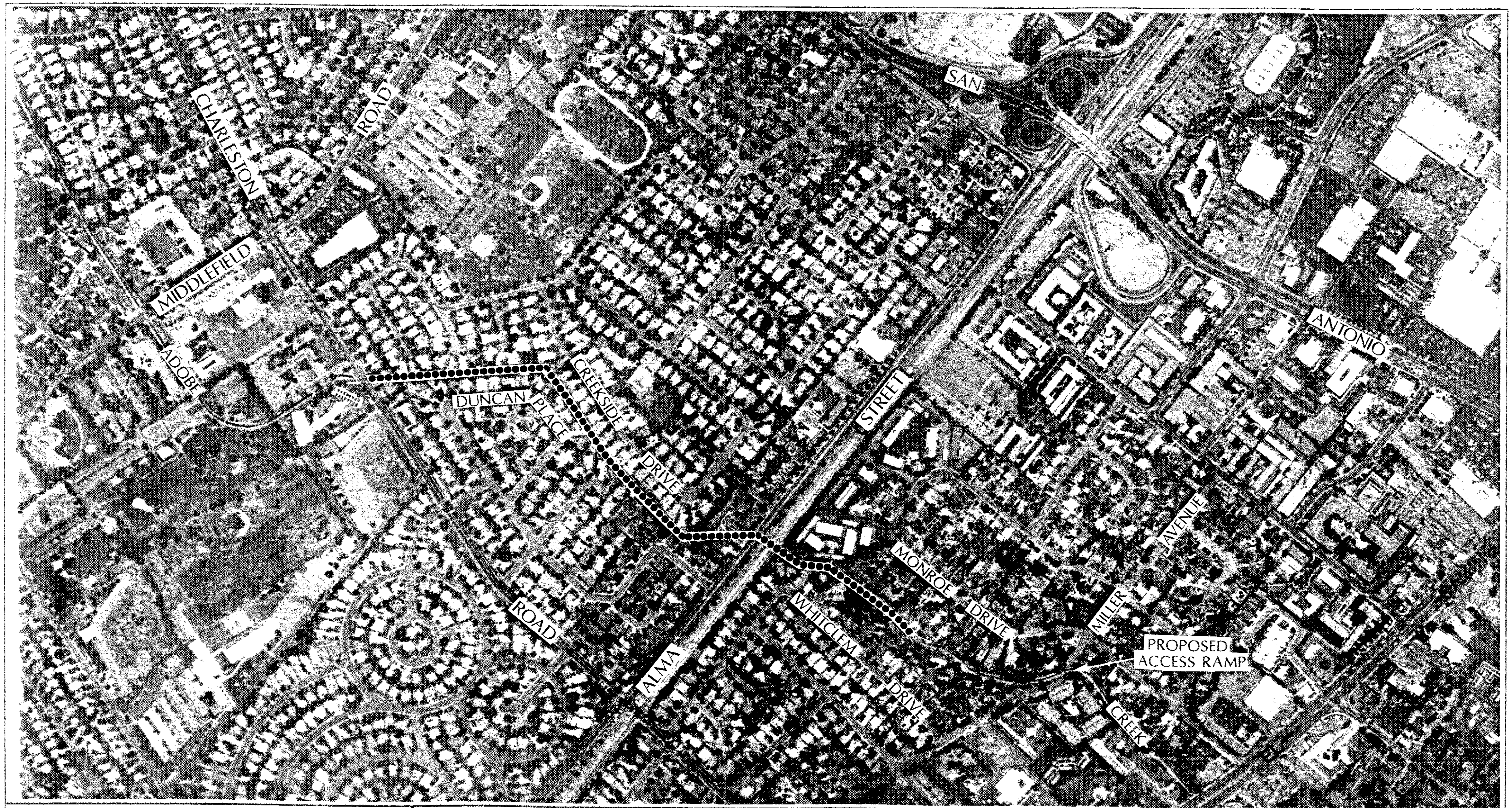
Typical construction of the channel would begin with the removal of the concrete channel lining, vegetation, fences and other structures (as required for construction), and the installation of a temporary construction fence. Temporary restraining systems (referred to as shoring and bracing systems) would be installed to stabilize the bank and adjacent ground during construction of the new U-frame channel. This shoring system could consist of sheet piles or soldier piles with lagging. Typical restraining systems are shown in Figure 9.

After installation of the shoring system, the expanded channel would be excavated to deepen the channel. The new concrete channel bottom would be poured, followed by forming and pouring of the new channel walls. After completion of the new channel and removal of concrete forms, backfill would be placed behind the channel walls to level the ground surface. Construction fencing would be removed and permanent fences reconstructed. Any damages to the adjacent backyards and structures would be repaired or compensated for monetarily.

Construction of the channel improvements would also include lowering of the channel bottom beneath the Alma Street bridge, as shown on Figure 6. The SP culvert would be removed and reconstructed. The existing railroad tracks would be temporarily relocated on to a new section of box culvert between the existing Alma Street bridge and existing SP railroad culvert during construction of the new culvert. The existing pedestrian footbridge between Duncan Place and Creekside Drive would also be removed (and reconstructed) during construction of the new channel.

Construction of the proposed channel improvements between Charleston Road and Alma Street is expected to last one to two construction seasons (April to October). Construction of the Alma Street bridge and SP culvert, and the channel replacement upstream of Alma Street would last approximately the same amount of time.

The short-term impacts of construction generally fall into two categories: construction nuisance (such as noise and dust) and the effects of ground movement caused by construction activities. Ground movement resulting from construction activities could cause settlement of the ground surface adjacent to the creek channel. This settlement could result in architectural and/or structural damage to houses, pools, sheds, patios, and other structures. In addition, lateral (horizontal) ground movement could result in damage to buried structures and vegetation, including swimming pools, utilities, and tree roots. Lateral and vertical ground



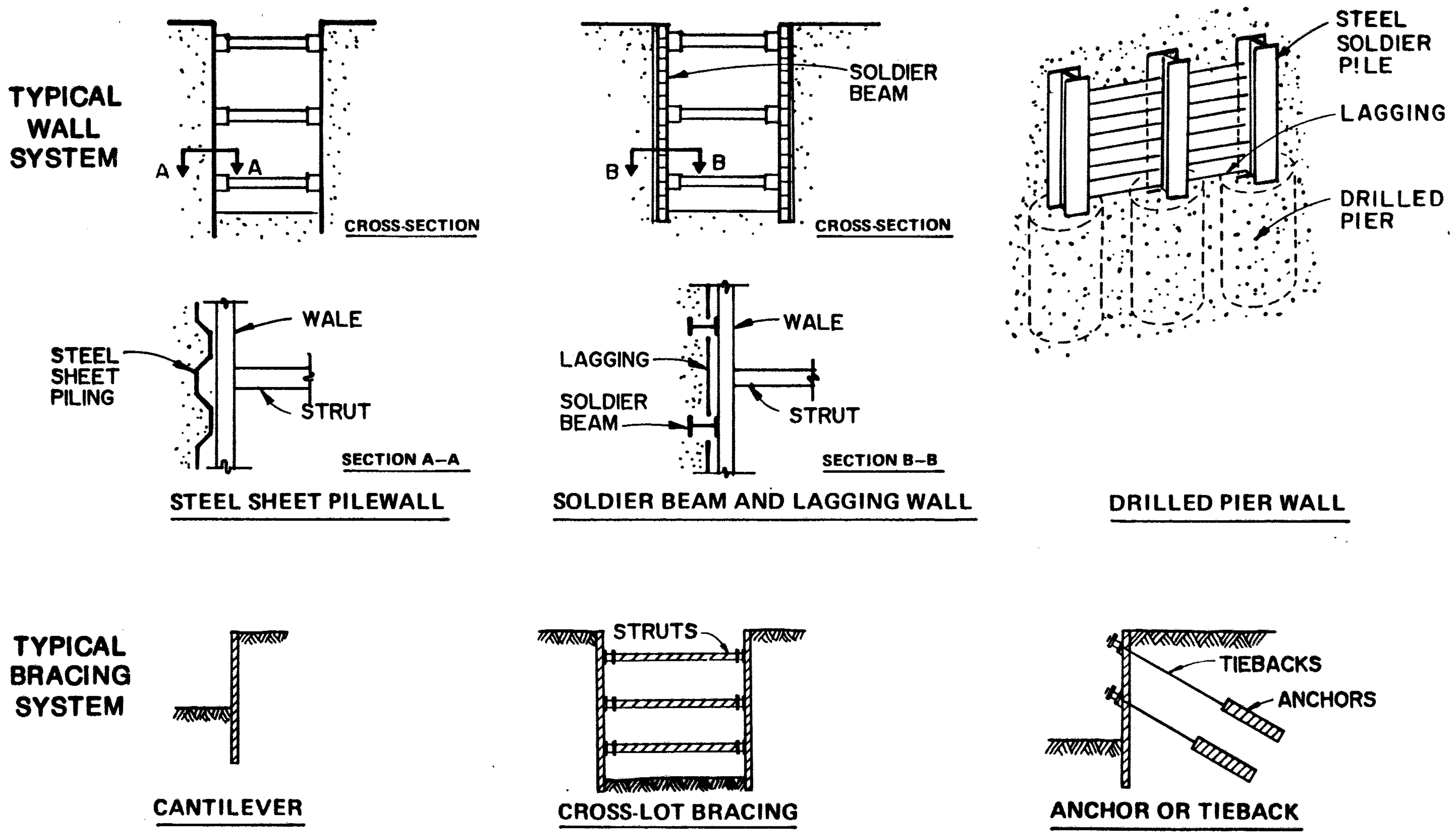
AERIAL PHOTOGRAPH

●●●●●● Proposed Channel Improvements

Base Map - Santa Clara County Aerial
1 inch equals 500 feet

N

FIGURE 8



TYPICAL TEMPORARY SHORING AND BRACING SYSTEMS FIGURE 9 movement during construction of the proposed project could potentially result from the three following activities:

1. Lateral movement of the temporary shoring and bracing;
2. Vibration of the ground from pile driving during installation of shoring system, and;
3. Subsidence caused by construction dewatering (removal of water beneath the area of construction)

### Shoring and Bracing

The installation of the shoring and bracing system could potentially result in ground movement. Bulging or lateral movement of the shoring would allow the soil behind the wall to slump toward the wall, thereby causing lateral movement of the soil in addition to settlement of the ground. Excessive shoring movement could be caused by an inadequately designed shoring and bracing system, poor quality construction of the shoring, or accidental failure of the shoring.

Settlement caused by excavation for the project could be a maximum of about one inch near the wall, and taper off to zero at about 20 feet from the shoring. Based upon the soil conditions at the site, the lateral ground surface movement would be approximately 0.5 inch at a distance of 15 feet from the wall. Potential lateral and vertical ground movement is shown on Figure 10. For both lateral and vertical ground movement, the type of shoring determines the amount of movement.

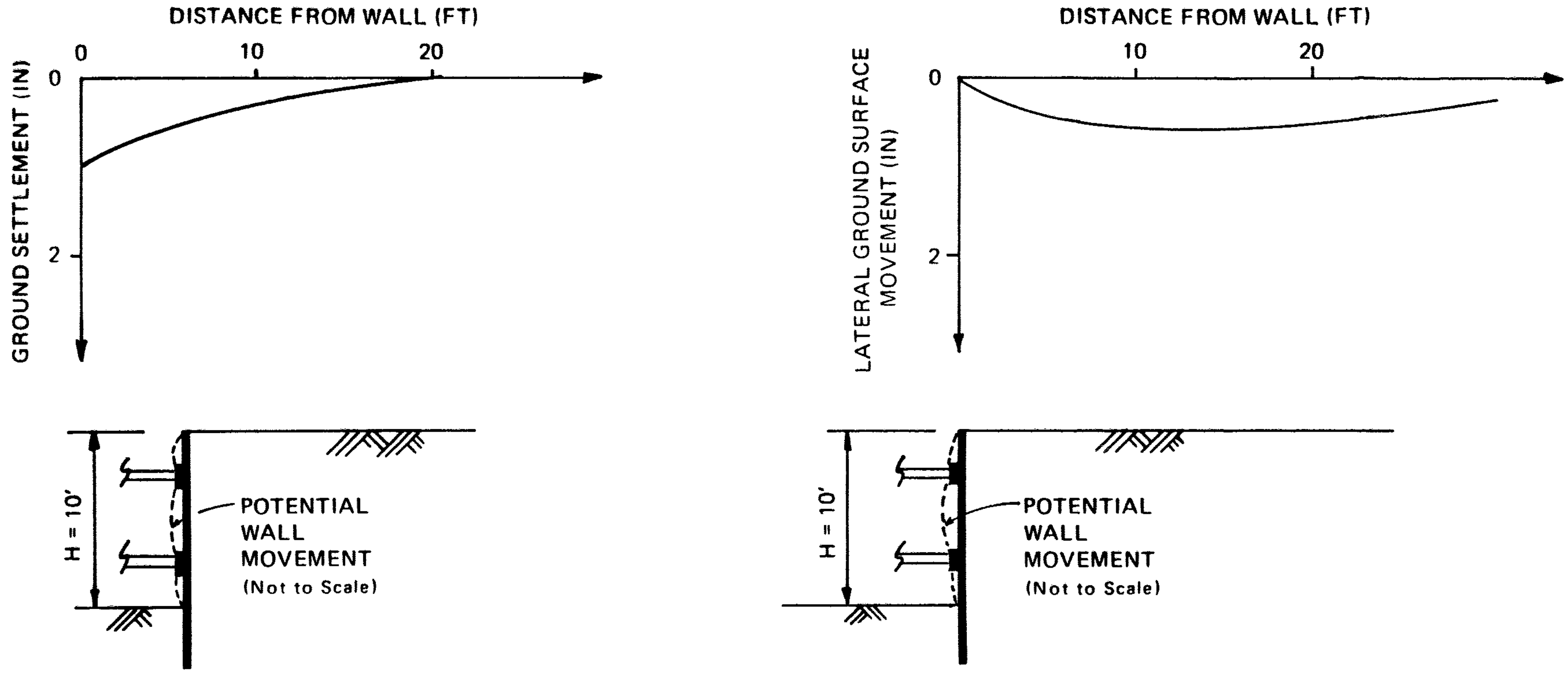
The above approximations of ground movement near the project site are based upon the assumption that the excavation is shored along its entire length, and that the shoring is adequately designed and constructed. Ground movement may be greater if the shoring is of inadequate stiffness, the bracing is inadequate or its installation delayed, the excavation is left open for a long period of time, or due to other factors, such as adverse weather and varying soil conditions.

The largest "permissible" amount of ground movement which could occur without damaging homes and other structures is highly dependent upon the type and condition of the structure and the local soil conditions.

### Pile Driving

Installation of driven piles for the bracing and shoring system would cause noise and vibrations in the surrounding ground. In loose to medium dense sandy soil, the vibrations tend to densify the soil and thus cause ground surface settlement. Based upon soil studies, the soils at the project site are not expected to be susceptible to this type of settlement. However, loose layers of sand could be present which were not encountered in the soil borings. In addition, any manmade sandy fill, such as backfill used for utility lines or swimming pools, may be susceptible to vibration induced settlement.

Pile driving vibrations can cause cosmetic and structural damage to surrounding structures, and can create a nuisance to neighbors. Vibrations generally become



**POTENTIAL VERTICAL GROUND MOVEMENT**

*(AFTER PECK, 1969)*

**POTENTIAL LATERAL GROUND MOVEMENT**

*(AFTER CLOUGH, 1985)*

POTENTIAL GROUND MOVEMENT FIGURE 10

unpleasant to humans at about 0.2 inches per second, and objectionable at about 0.6 inch/second. The recommended safe vibrational level for residences is 2.0 inch/second. (Residential plaster cracks at about 5.0 inch/second.)

The vibration intensity caused by pile driving depends on the type of pile driving equipment and the soil conditions on the site. Driving sheet piles with a vibratory pile driver at the project site could create ground vibrations of about 5 inch/second at about five feet from the pile. The vibration intensity would decrease with distance from the pile. Buildings and other structures may be subject to damaging vibrations within 10 feet of the pile driving operation. Humans may find the vibrations objectionable within about 100 feet of the pile driving.

### Demolition

The demolition of the existing concrete channel may be completed with a backhoe mounted jackhammer or similar heavy equipment. The demolition activities would result in dust, noise, and vibration to the surrounding area. The vibration levels during demolition are difficult to predict, but could be on the order of 0.5 inch/second at about five feet from the demolition.

### Dewatering

Excavation dewatering may be required depending upon the groundwater level encountered during construction. This dewatering could result in settlement near the project site.

### Settlement

As with the temporary shoring and bracing system, ground movement could occur if the permanent channel wall rotated inward toward the channel. If backfill behind the channel wall were improperly compacted, settlement could occur over the long term.

### Potentially Impacted Properties and Structures

Construction of the project could result in potential damage to homes and property located along the creek channel. Vibrations and other land disturbances caused by construction activities could damage foundations and heating systems, swimming pools, fencing, landscaping, vegetation and yards. A list of the homes which may potentially be impacted by the proposed project is presented in Table 1. Twenty three homes are located within the potential zone of settlement (20 feet from the top of the channel bank). Other potentially impacted structures, such as swimming pools, sheds, and patios are listed in Table 2. (A discussion of the impacts to vegetation is contained in the VEGETATION AND WILDLIFE section of this EIR.)

Most of the residences along the project portion of Adobe Creek are referred to as "Eichler" homes. These houses consist of a concrete slab foundation and a wood-framed superstructure. Many of the homes have large plate glass windows and sliding glass doors. Eichler homes were constructed with radiant heating systems.

# TABLE 1

# POTENTIALLY IMPACTED HOUSES

| Name | Address | Approx. Creek Station* | Approx. Distance from Existing Top of Channel Lining (ft) | Comments |
|---|---|---|---|---|
| Justice | 465 El Capitain Pl. | 198+00 | 4 | 2-4 ft roof overhang |
| Becker | 455 El Capitain Pl. | 198+00 | 7 | 2 ft roof overhang |
| Liang | 3990 Duncan Pl | 199+00 | 9 | |
| Van de Put | 3954 Nelson Ct. | 200+50 | 3 | |
| Wheeler | 3956 Nelson Ct. | 201+00 | 5 | 2 ft overhang |
| Lindholm | 411 Adobe Pl. | 203+00 | 6 | 2 ft overhang |
| Fung | 3934 Duncan Pl. | 205+00 | 14 | house addition near creek |
| Morris | 345 Creekside Dr. | 206+00 | 10 | cracks in floor slab, radiant heat operable |
| Olmstead | 331 Creekside Dr. | 206+50 | 10 | 2 ft overhang |
| Barnes | 317 Creekside Dr. | 207+00 | 2 | 2 ft overhang |
| Morrision | 3902 Duncan Pl. | 208+50 | 8 | |
| Wall | 291 Creekside Dr. | 209+00 | 6 | |
| Haines | 281 Creekside Dr. | 210+00 | 6 | baseboard heating (not in slab), 2 ft overhang |
| Vanderiet | 271 Creekside Dr. | 211+00 | 2 | |
| Staehnke | 3895 Mumford Pl. | 211+50 | 14 | |
| Brann | 251 Creekside Dr. | 212+00 | 11 | 2 ft overhang |
| Elspas | 130 Ely Pl. | 217+00 | 8 | |
| Okner | 207 Creekside Dr. | 214+50 | 15 | |
| Gilberg | 209 Creekside Dr. | 215+00 | 14 | |
| Scolas | 135 Green Meadow Way | | 5 | 2 ft overhang |
| Kennedy | 119 Green Meadow Way | 219+00 | 6 | 6 ft overhang |
| Drapkin | 3943 Alma St. | 219+00 | 15 | |
| Stietzel | 239 Whitclem Ct. | 224+50 | 18 | |

*Correponds with station numbers on project plans (on file with SCVWD).

## TABLE 2

## POTENTIALLY IMPACTED STRUCTURES[1]

| Name | Address | Approx. Creek Station* | Type of Structure | Approx. Distance from Existing Top of Channel Lining |
|---|---|---|---|---|
| Justice | 465 El Capitain | 198+00 | Small office, separate from house, along fence | 2 ft |
| Kirkeby | 3998 Duncan Pl. | 198+00 | Pool,7 ft wide patio between pool and channel, aluminum shed | 4 ft |
| Liang | 3990 Duncan Pl. | 199+00 | Swimming pool (plastic liner with sand backfill, 30'X 12'X 8'), pool pump, fittings, underground pipes along fence, concrete patio | 8 ft |
| Preston | 3918 Duncan Pl. | 207+00 | Concrete-lined pool, concrete patio between pool and fence | 10 ft |
| Morrision | 3902 Duncan Pl. | 208+50 | Concrete-lined pool, concrete patio to fence, fence supports small wood overhang | 6 ft |
| Grandberg | 3875 Mumford Pl. | 210+00 | Concrete-lined pool (30'X 15'X 8'), 3' wide patio on channel side of pool, piping & equipment | 15 ft |
| Berwald | 261 Creekside Dr. | 211+50 | Pool | 5 ft |
| Staehnke | 3895 Mumford Pl. | 211+50 | Concrete-lined pool, ornamental weaving along fencing, pool pump & equipment along fence, solar heating pipes on fence, concrete patio between pool & fence | 3 ft |
| Cooke | 131 Green Mdw Wy. | 219+00 | Concrete-lined pool, 8' patio between pool and channel, wood bench, circular sun deck | 4 ft |

[1] Other than houses

* Corresponds with station numbers on project plans (on file with the SCVWD).

These heating systems consist of copper or galvanized steel tubing embedded in the concrete slab which circulate hot water to provide heat to the home.

Ground settlement caused by construction activities could result in cracking of the concrete slab foundation system, and could also cause nonstructural cracks in the interior walls or exterior siding. Damage to the slab foundation could cause rupturing of the radiant heat tubing, making the heating system inoperative and create water damage to carpet and interior furnishing. This could lead to additional settlement if the subgrade below the slab foundation became saturated from leaks in the heating system. Structural damage to the woodframe superstructure is not likely (CH2M Hill, 1989).

Eight swimming pools are also located within the zone of potential settlement. Seven of the pools are concrete lined, either rectangular, oval, or kidney shaped. Potential impacts to the concrete or masonry pools include rotation or tilting of the pool walls leading to cracks in the masonry. The eighth pool (located at the Liang residence) was constructed with a plastic liner backfilled with sand. Construction vibrations from the project may cause settlement or shifting of the sand backfill, thus distorting or damaging the plastic liner.

### Short-Term Noise and Air Quality Impacts

Construction activities would result in temporary noise and air quality impacts to the surrounding residences. The following discussion of these noise and air quality impacts is based upon a construction noise/air quality assessment of the project conducted by MO'C Physics Applied, contained in Appendix D of this EIR.

The use of diesel-powered heavy equipment, jackhammers, and gasoline powered chain saws would result in high noise levels adjacent to the project site. Pumps may be used to transport water around the construction area. (These pumps could operate 24 hours a day.) A list of the noise levels from typical construction equipment (at 25 feet) is as follows[3]:

| Equipment | Noise Levels at 25 feet (decibels) |
|---|---|
| backhoes | 78-99 |
| loaders | 78-90 |
| dump trucks | 89-100 |
| cement trucks | 89-100 |
| cranes | 82-93 |
| chain saws | 90-100 |
| pavement breakers | 82-92 |
| jackhammers | 88-103 |
| pile drivers | 100-110 |

---

[3] Noise levels change six decibels for every doubling of distance from the noise source. For example, a tool which produces noise of 95 decibels at 25 feet registers at about 101 decibels at 12.5 feet, and about 107 decibels at six feet.

It should be noted that much construction would take place along back property lines, within a few feet of adjacent residences. The noise resulting from construction in these areas would exceed local noise standards.

The noise levels resulting from construction of the proposed channel improvements could be high enough to cause significant levels of speech interference (inability to hear speech) within the adjacent homes, even with the windows closed. This construction noise could also affect pets in the project area.

Construction activities could also result in local air quality (dust) impacts. Construction and demolition activities would raise dust and construction vehicles would raise dust and track mud and dust on to local streets. Exhaust from the construction equipment would not increase localized ozone concentrations, nor would it result in detectible ozone concentrations downwind.

### Short-Term Privacy and Security Impacts

The project would result in short-term privacy and security impacts on homes adjacent to the creek channel during the construction phase when fences and other property barriers are removed. It is expected that most backyard fences between Alma Street and Charleston Road adjacent to the project would be removed during construction. Pets would also be affected by construction activities and could escape from backyards during fence removal and temporary fence installation.

### Footbridge Replacement Impacts

The footbridge located over Adobe Creek between Duncan Place and Creekside Drive would be temporarily removed and replaced as part of project construction. This footbridge would be unusable during channel and footbridge removal and installation, resulting in impacts to foot and bicycle traffic for a period of approximately two to four months. Foot and bicycle traffic would have to use either the Charleston Road or Alma Street bridge during the time when the footbridge is unusable. The temporary loss of footbridge access is not a significant adverse impact, because the detour distance would not be substantial.

### Railroad Relocation Impacts

The SP railroad culvert across Adobe Creek would be reconstructed as part of the project. This would require relocation (or "shoofly") of the rail line on to a new section of culvert located between the existing Alma Street bridge and the SP railroad culvert.

Relocation of the rail line may require replacement of a City of Mountain View 84-inch storm drain line. Prior to construction, this storm drain line would be tested to determine its strength. If the line is not strong enough to support temporary railroad loads, it would be replaced, resulting in construction impacts including the removal of several large trees and shrubs along Alma Street.

Relocation of the rail line could impact oncoming automobile traffic along Alma Street by creating glare from the train headlamp. Relocation of the rail line closer to Alma Street could also result in potential noise impacts to residences located north of Alma Street. The residences located south of Alma Street may experience a slight decrease in noise as a result of railroad relocation.

### Utility Relocation Impacts

In order to construct the new channel, some of the existing power poles adjacent to the creek would have to be relocated. These power poles would be moved further away from the creek, into the backyards of bordering residences (remaining within the existing SCVWD right-of-way). A City of Palo Alto 8-inch water line would also have to be relocated.

In addition, several of the properties near the project site have underground utilities (i.e. private gas and power lines serving swimming pools, etc.) along the backyard fences which would require relocation during channel construction. The relocation of utilities would result in short-term service interruptions.

### Traffic Impacts

The access of construction vehicles onto the project site from Alma Street, Charleston Road, and Miller Avenue (for access ramp construction) would result in traffic impacts on these streets. In addition, the reconstruction of the railroad culvert would have short-term impacts on traffic on Alma Street. Traffic impacts would also occur from trucks and other construction vehicles travelling on other connecting streets to the project.

The construction impacts described above represent significant adverse short-term impacts. Several of the specific construction impacts would be significant and unavoidable.

## 3. Mitigation

Construction impacts can be reduced or avoided by implementation of several mitigation measures described within this mitigation section.

Specific impacts to properties located along the Adobe Creek channel would be mitigated by a monitoring program, shoring and bracing systems, a pre-and post-construction survey, and protection and repair of existing structures as described below.

### Monitoring

Monitoring measures would be implemented throughout the construction period to detect ground movement or vibrations. Remedial measures can then be taken should settlement or vibrations become excessive. The exact location and the frequency of measurement of the monitoring devices would be determined during final project design. Monitoring devices could include the following:

Settlement monuments, to measure the amount of any settlement, located at various distances from the construction activity, and at strategic locations near potentially impacted structures.

Borings, with inclinometer casing, located near the excavation wall in the most critical areas to permit measurement of lateral ground movement that may result from the proposed excavation and permanent wall.

Vibration monitors installed on or near the potentially impacted structures to measure vibration intensity during pile driving and demolition activities.

After project completion, the settlement monuments and slope inclinometers could be measured to detect movement of the channel wall and surrounding ground.

### Shoring and Bracing System

The shoring and bracing system would be designed and installed to specifically control ground movement. This would include the installation of an adequately stiff wall and sufficient bracing. Monitoring of potential ground movement could also take place throughout the construction period. As stated previously, the largest amount of ground movement that could occur without damaging houses and other structures is highly dependent upon the type and condition of the structure and the local soil conditions. This would be determined during final design of the project. The design and installation of the shoring and bracing system would be the responsibility of the contractor.

### Pre- and Post-Construction Survey

A survey of all potentially impacted structures would be performed prior to construction to assess the existing conditions of these structures. This survey would include the photographing and written documentation of the existing condition of structures (including cracks or other damage). The same structures would be surveyed upon construction completion and compared with the pre-construction survey to evaluate the impacts, if any. All surveys would be performed by a registered civil or structural engineer (California registration).

### Protection and Repair of Existing Structures

Prior to commencing construction, several remedial measures would be taken to protect existing structures in the project area. Strong tape could be placed across plate glass windows and sliding glass doors to reinforce and protect the glass from excessive vibration. Swimming pools within the potential zone of settlement could be drained prior to construction for a construction season. Smaller structures, such as sheds, wood fences, and swimming pool pumps and equipment, could be removed and replaced after construction is complete.

Structures which are damaged as a result of project construction would be repaired or replaced.

### Short-Term Noise and Air Quality Impacts

Short-term noise and air quality impacts would be mitigated by implementation of the City of Palo Alto regulations for noise and dust, which would be contained in the contract specifications.

The SCVWD requires that dust be controlled in the vicinity of residential areas. In addition, the SCVWD requires that all construction operations be in accordance with the City of Palo Alto Noise Ordinance (maximum of 110 dBA for construction equipment).

In addition to the above regulations, the following mitigation measures are proposed:

1. Noise would be reduced by the construction of temporary plywood barriers along the backyards of adjacent residences.
2. The construction area would be watered and the pavement swept as necessary to reduce dust in the project area.
3. Pavement breakers would be used instead of jackhammers where possible to reduce noise levels. Pumps used for diverting water flows would be enclosed to reduce noise emissions.

The above measures would reduce the noise impacts of the project; however, they would not mitigate them to a level of nonsignificance. The air quality (dust) impacts would be reduced to a level of nonsignificance with the implementation of mitigation measures.

### Short-Term Privacy and Security Impacts

Temporary construction fencing (plywood barrier) would be installed to replace backyard fences removed during construction. This fencing would remain in place throughout the duration of construction and would provide security and privacy. Permanent fences would either be replaced in kind or replaced with six foot redwood fences after project construction.

### Footbridge Replacement Impacts

The existing footbridge across Adobe Creek would be unusable for approximately two to four months during construction. A temporary footbridge could not be relocated within the project area since it would interfere with construction activities. Therefore, this impact cannot be mitigated. However, signs would be posted to direct bicycle and pedestrian traffic to Charleston Road.

### Railroad Relocation Impacts

A glare screen would be installed for a few hundred feet along Alma Street to reduce potential glare from train headlamps. The potential noise impacts to residents located to the north of Alma Street would not be significant.

### Utility Relocation Impacts

Channel construction would require the relocation of some power poles. Since many of the existing power poles in the project area are already located within the backyards of adjacent residences, this does not represent a significant impact and, therefore, no mitigation is required.

Underground utilities located within the backyards of adjacent residences would be relocated during construction as necessary. Any damage to these utilities would be repaired or replaced.

### Traffic Impacts

At least one lane in each direction should remain open on Alma Street and Charleston Road at all times during project construction to allow for through traffic. The movement of construction vehicles and other activities affecting traffic would be coordinated with the City of Palo Alto to minimize traffic impacts. In addition, construction vehicles would adhere to the City of Palo Alto and City of Mountain View truck regulations and routes.

## B. PUBLIC SAFETY

### 1. Setting

Creek channels generally present a hazard to public safety, because of the difficulty of escape should a person accidentally fall into the channel. The existing creek channel consists of a concrete trapezoidal channel with very steep side slopes, bordered for most of its length by fences. There are no existing ladders along the project portion of the channel.

### 2. Impacts

The proposed channel design of vertical channel walls present a somewhat greater hazard to the public than the trapezoidal channel. Vertical channel walls are very difficult to climb out of if a person accidentally falls into the creek. However, the existing trapezoidal channel is also steep and difficult to escape; therefore, the project would not result in significantly increased public safety hazards.

### 3. Mitigation

The SCVWD is proposing a chain link fence on top of the channel wall where the wall is less than 48 inches above the surrounding ground. In addition, the SCVWD is proposing to construct steel ladders periodically along the creek channel to facilitate rapid and easy access to and from the U-frame channel, should a rescue be necessary.

# C. GEOLOGY

## 1. Setting

The following discussion on geology is based upon a geotechnical assessment conducted for the project site by CH2M Hill. This geotechnical report is contained in Appendix C of this EIR.

Soils in the project area consist of the Santa Clara Formation alluvial deposits. These sediments were deposited from streams that drained from the Santa Cruz Mountains. Previous geologic studies of the project site indicate that the surface soils are black to brown and silty to sandy for a depth of 10 feet. From 10 to 20 feet, the soils are reddish-brown to brown gravelly sandy clay. Groundwater is expected at or below the bottom of the existing creek channel.

The Santa Clara Valley area is recognized as a seismically active region. The active faults located near the project site are as follows: the San Andreas (8 miles to the southwest), the Hayward (11 miles to the northeast), and the Calaveras (16 miles to the northeast). Each of these faults is considered active and capable of generating large magnitude earthquakes.

## 2. Impacts

### Seismic Hazards

Due to its proximity to several active faults, it is expected that the project area will be subject to ground shaking from at least one moderate to severe earthquake during the life of the project. The fault zone of primary concern to this project is the San Andreas.

Liquefaction is another seismic hazard in which soils are temporarily transformed into a liquid state during the stress of an earthquake. According to the geotechnical consultants, liquefaction of the subsurface material beneath the proposed channel improvements is unlikely.

## 3. Mitigation

### Seismic Hazards

Damage to the channel improvements from seismic hazards would be reduced by designing the proposed creek channel to withstand the lateral pressures resulting from the maximum expected ground acceleration at the project location (0.45 g).

## D. VEGETATION AND WILDLIFE

### 1. Setting

#### Vegetation

The existing concrete lined channel supports virtually no vegetation, other than ivy growing down from the above channel walls. A very narrow strip of vegetation is located at the top of the concrete lining channel wall and the adjacent backyard fences. This area is from six to eighteen inches wide along most of the creek. Very little vegetation grows in this strip. Most of these plants are volunteers which have seeded themselves or sprouted from the adjacent backyards. Several young oaks occur along the top of the right bank just upstream of Charleston Road. At least three stands of coyote brush were also observed along the bank tops. Other native plant species which occurred as individual or random specimens include blue elderberry, mugwort, and blackberry. A number of young valley oak and coast live oak seedlings were found in the strip between the creek channel and backyard fences. An oak tree (possibly a golden oak) approximately fifteen feet in height is located on the right bank just downstream of the Alma Street culvert. The only vegetation growing within the channel are a few young cattails.

The vegetation along the backyard fences bordering the creek channel between Charleston Road and Alma Street consists primarily of non-native ornamental trees and shrubs. A list of the trees along the creek channel between Charleston Road and Alma Street is contained in Table 3.

Upstream of the Southern Pacific railroad culvert, there are several mature pines, young live oaks, and other trees that were not inventoried and listed in Table 3. Thirteen coast live oak trees, approximately 6-15 feet in height, are located along the top of the east bank of the channel. On the west bank of the channel, there are two 20 foot tall coast live oaks and one 50 foot coast live oak. Blackberry and English ivy is present a some locations on the upper banks above the concrete lining although most of the ground is bare. Other plants that are present include wild rose, mugwort, and blackberry. The vegetation in the adjacent backyards consists of some live oaks trees, and many ornamental trees including eucalyptus, black walnut, pepper, and Monterey pine.

#### Wildlife

The undeveloped strip of earth between the channel and backyard fences along the project portion of the creek is too narrow to be of significant habitat value. The only wildlife along the project portion of the creek channel are those species which have become adapted to residential yards. Some of the wildlife observed were mourning doves, American robins, flickers, scrub jays, mockingbirds, black phoebes, brown towhees, bushtits, and fox and tree squirrels.

# TABLE 3

## POTENTIALLY IMPACTED TREES
## Charleston Road to Alma Street

| No.[1] | Name | Size | Location |
|---|---|---|---|
| 4. | Juniper | 4" | Downs |
| 5. | Palm | 18" | " |
| 6. | Palm | 12" | " |
| 7. | Palm | 12" | " |
| 8. | Unidentified[2] | 24" | Becker |
| 9. | Mimosa | 6" | " |
| 10. | Unidentified | 8" | " |
| 11. | Mimosa | 11" | " |
| 12. | Plum | 24" | " |
| 13. | Unidentified | 6" | Golden |
| 14. | Unidentified | 6" | " |
| 15. | Unidentified | 4" | " |
| 16. | Unidentified | 5" | Kadis |
| 17. | Unidentified | 6" | " |
| 18. | Plum | 8" | " |
| 19. | White Birch | 6" | Van De Put |
| 20. | White Birch | 6" | " |
| 21. | Maple | 8" | Wheeler |
| 22. | Cypress | 9" | " |
| 23. | Plum | 9" | " |
| 24. | Apricot | 8" | Thompson |
| 25. | Plum | 4" | " |
| 26. | Plum | 4" | " |
| 27. | Eucalyptus | 30" | Lindholm |
| 28. | Apple | 6" | " |
| 29. | Apricot | 9" | " |
| 30. | Eucalyptus | 26" | " |
| 31. | Unidentified | 16" | Newell |
| 32. | Elm | 5" | " |
| 33. | Unidentified | 9" | " |
| 34. | Redwood | 2" | " |
| 35. | Pepper | 35" | Wang |
| 36. | Unidentified | | Boehrs |
| 37. | " | | " |
| 38. | " | | " |
| 39. | " | | " |
| 40. | Eucalyptus | 14" | Olmstead |
| 41. | Eucalyptus | 20" | " |
| 42. | Unidentified | 18" | Porter |
| 43. | Unidentified | 18" | " |
| 44. | Redwood | 4" | " |
| 45. | Willow | 18" | Fay |
| 46. | Walnut | 20" | Haines |
| 47. | Olive | 12" | Haines |
| 48. | Loquat | 8" | Palmer |
| 49. | Elm | 18" | Shapero |
| 50. | Unidentified | | " |
| 51. | Unidentified | 8" | " |
| 52. | Locust | 7" | Okner |
| 53. | Orange | 5" | " |
| 54. | Unidentified | | " |
| 55. | Alder | 13" | Gilbarg |
| 56. | Unidentified | 8" | Tract 4927 |
| 57. | Unidentified | 1" | " |
| 58. | Mulberry | 6" | " |
| 59. | Unidentified | | Ahrens |
| 60. | " | | " |
| 61. | " | | " |
| 62. | " | | " |
| 63. | " | | " |
| 64. | Cedar | 8" | Kirkeby |
| 65. | Fruit | 8" | " |
| 66. | Cedar | 9" | " |
| 67. | Redwood | 3" | " |
| 68. | Redwood | 4" | " |
| 69. | Redwood | 13" | " |
| 70. | Unidentified | 15" | Liang |
| 71. | Loquat | - | " |
| 72. | Unidentified | 8" | " |
| 73. | Unidentified | 6" | " |
| 74. | Unidentified | 14" | " |
| 75. | Willow | 12" | Lobato |
| 76. | Fruit | 6" | " |
| 77. | Fruit | 10" | " |
| 78. | Birch | 5" | " |
| 79. | Unidentified | 12" | " |
| 80. | Unidentified | 5" | " |
| 81. | Citrus | 2" | Lubow |
| 82. | Fig | 1" | " |
| 83. | Citrus | 2" | " |
| 84. | Citrus | 2" | " |
| 85. | Plum | 3" | " |
| 86. | Citrus | 5" | " |
| 87. | Citrus | 3" | " |
| 88. | Unidentified | 2" | " |
| 89. | Fir | 24" | " |

(continued)

## TABLE 3

## POTENTIALLY IMPACTED TREES
### Charleston Road to Alma Street
### (Continued)

| No.[1] | Name | Size | Location |
|---|---|---|---|
| 90. | Loquat | 3" | Lubow |
| 91. | Citrus | 4" | Schnitzer |
| 92. | Cherry Plum | 4" | " |
| 93. | Japanese Maple | 3" | " |
| 94. | Unidentified | 2" | " |
| 95. | Japanese Maple | 3" | " |
| 96. | Avocado | 3" | " |
| 97. | Orange | 6" | Dau |
| 98. | Pear | 5" | " |
| 99. | Pine | 24" | " |
| 100. | Eucalyptus | 6" | Collins |
| 101. | Oak | | " |
| 102. | Eucalyptus | 6" | " |
| 103. | Eucalyptus | 8" | " |
| 104. | Eucalyptus | 8" | " |
| 105. | Eucalyptus | 8" | " |
| 106. | Oak | | " |
| 107. | Eucalyptus | 12" | " |
| 108. | Unidentified | | Johnson |
| 109. | Unidentified | | " |
| 110. | Unidentified | | " |
| 111. | Unidentified | | " |
| 112. | Maple | 10" | Fung |
| 113. | Maple | 10" | " |
| 114. | Citrus | 5" | Putnum |
| 115. | Citrus | 5" | " |
| 116. | White Birch | 9" | " |
| 117. | Unidentified | 14" | Preston |
| 118. | Unidentified | | Kyle |
| 119. | Unidentified | | " |
| 120. | Unidentified | | " |
| 121. | Unidentified | | " |
| 122. | Unidentified | | " |
| 123. | Unidentified | | " |
| 124. | Olive | 2" | Morrison |
| 125. | Olive | 2" | " |
| 126. | Unidentified | 6" | Grandburg |
| 127. | Fir | 9" | " |
| 128. | Unidentified | 4" | Tincher |
| 129. | Black Walnut | 4" | " |
| 130. | Black Walnut | 4" | " |
| 131. | Black Walnut | 4" | " |
| 132. | Black Walnut | 4" | " |
| 133. | Plum | 6" | " |
| 134. | Plum | 6" | " |
| 135. | Apricot | 10" | " |
| 136. | Apricot | 6" | " |
| 137. | Oak | 12" | " |
| 138. | Black Walnut | 10" | " |
| 139. | Plum | 10" | Staehnke |
| 140. | Apple | 12" | " |
| 141. | Pine | 20" | Schmitz |
| 142. | Pepper | 18" | Hart |
| 143. | Pine | 24" | Glauz |
| 144. | Magnolia | 6" | " |
| 145. | Lemon | 5" | " |
| 146. | Maple | 12" | " |
| 147. | Eucalyptus | 9" | Norberg |
| 148. | Eucalyptus | 10" | " |
| 149. | Unidentified | 10" | " |
| 150. | Plum | 4" | " |
| 151. | Unidentified | 10" | " |
| 152. | Unidentified | 14" | " |
| 153. | Fruit | 6" | " |
| 154. | Pine | 24" | " |
| 155. | Unidentified | 6" | Elspas |
| 156. | Pine | 16" | Drapkin |
| 157. | Pine | 14" | " |
| 158. | Pine | 18" | " |
| 159. | Pine | 10" | " |
| 160. | Redwood | 16" | " |
| 161. | Redwood | 20" | " |
| 162. | Redwood | 18" | " |
| 163. | Pepper | 5" | " |

---

[1] Corresponds with tree numbers on project plans (on file with SCVWD)

[2] Species and/or size of tree unconfirmed.

### 2. Impacts

#### Vegetation

The replacement of the existing concrete creek channel may result in a loss of the vegetation growing on the upper portion of the channel banks and along the top of the channel banks inside the backyard fencelines.

Many trees located within backyards adjacent to the channel would be removed for construction of the proposed channel walls (refer to Table 3 for tree list). In addition to the trees that would be removed by construction, some trees may suffer root damage during construction and may subsequently die. Trees not removed may also be trimmed for project construction. Vegetation removed by the project represents a substantial loss of landscaping to backyards. However, this loss of vegetation does not represent a significant loss of wildlife habitat. Therefore, it is not considered a significant impact from a biological perspective.

Possible replacement of a storm drain near the SP railroad culvert would require the removal of several trees and shrubs along Alma Street.

#### Wildlife

Construction of the proposed channel improvements would disturb existing wildlife in the project area. Some of the wildlife species which inhabit the adjacent backyards could be temporarily or permanently displaced. However, due to the limited habitat value of the site, the impact of the project upon wildlife would not be significant.

### 3. Mitigation

The project would monetarily compensate each homeowner for the loss of all vegetation removed. The appraised value of vegetation would be determined by a licensed arborist, tree surgeon, or other professional qualified to make such appraisals. Any trees or shrubs removed along Alma Street would be replaced by the SCVWD.

## E. VISUAL

### 1. Setting

The existing visual character of the project area is that of a concrete-lined trapezoidal channel incised between the backyards of single family homes. The channel serves as a open space separation between backyards. Backyard fences, approximately five to seven feet high are located above the channel walls, as shown in Photos 1, 2, and 3. Many of these fences are covered with ivy or other vegetation, but in the narrow areas between the channel walls and fences, there is limited vegetation growth. Flanking the channel is residential backyard landscaping including substantial mature trees and shrubs. The visual character of the channel and adjacent backyards also includes utility poles and overhead lines which parallel the channel.

The views of the Adobe Creek channel are limited to perspectives over or through backyard fences, from the Charleston Road and Alma Street bridges, and from the footbridge over the channel between Duncan Place and Creekside Drive. Views from the footbridge are shown in Photos 1 and 2, and the footbridge is shown in Photo 4. The view of the creek channel from the Charleston Road bridge is shown in Photo 5, which was taken during construction of the channel improvements at this bridge. A view of the channel from the Alma Street bridge looking downstream is shown on Photo 6. The Alma Street bridge is illustrated in Photo 7 as seen from the creek channel looking upstream. Photo 8 is a view of the Southern Pacific railroad culvert as seen from the channel upstream.

## 2. Impacts

Construction of the project would significantly alter the visual character of the adjacent backyards by removal of landscaping including mature trees and shrubs (as described previously under CONSTRUCTION IMPACTS). A dramatic change would result from the removal of back fences covered with ivy or other vegetation. With the removal of large mature trees, the utility poles and overhead lines would become more noticeable; in addition, some utility poles may be relocated a few feet during construction. From the perspective of adjacent backyards, the visual character would also change from the construction of channel walls from 2.0 to 4.9 feet high above the existing ground along the top of the new channel. Table 4 presents a list of the channel wall heights along the channel by station and property owner. These channel walls would result in a visual impact from the backyards of adjacent homes and from the bridges at Charleston Road and Alma Street. The extent of the visual impact would correspond to the height of the channel wall and the height and type of the existing fence. Some of the channel walls would be hidden behind existing wood fences. The visual impacts of the channel walls would be reduced by the proposed construction of wood fences adjacent to the channel walls. The greatest visual impact of the project would result from removal of mature trees and shrubs that would take several years to replace. In some cases replacement of large and/or slow growing trees would take more than a decade before replacement trees are of comparable size to the tree removed. The project would, therefore, have a significant visual impact during the time replacement landscaping is maturing.

The new footbridge between Duncan Place and Creekside Drive would be constructed approximately 2.5 to 3 feet higher than the existing bridge. This would reduce privacy and create visual impacts to the backyards of the four adjacent residences (since bicyclists and pedestrians could see into these yards from the higher footbridge).

## 3. Mitigation

The height of the proposed channel walls would be limited to 4.9 feet or less above the top of the channel. The project proposes to replace the existing fences in kind, or to construct wood fences (a minimum of six feet in height) to screen the proposed floodwalls.

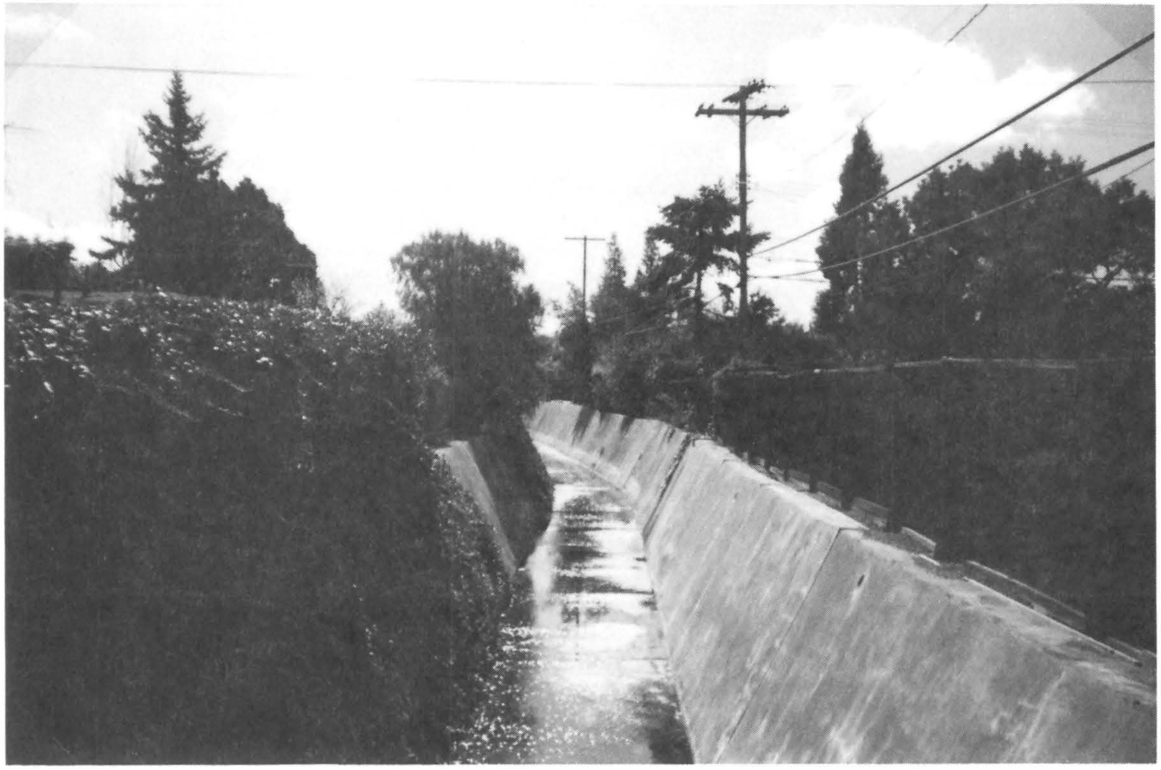


**PHOTO 1** was taken looking upstream from the footbridge over Adobe Creek between Duncan Place and Creekside Drive. The right side of the photo shows the backyard fences adjacent to the top of the concrete channel lining. The fences on the opposite side of the channel are covered with ivy that extends down the channel wall.

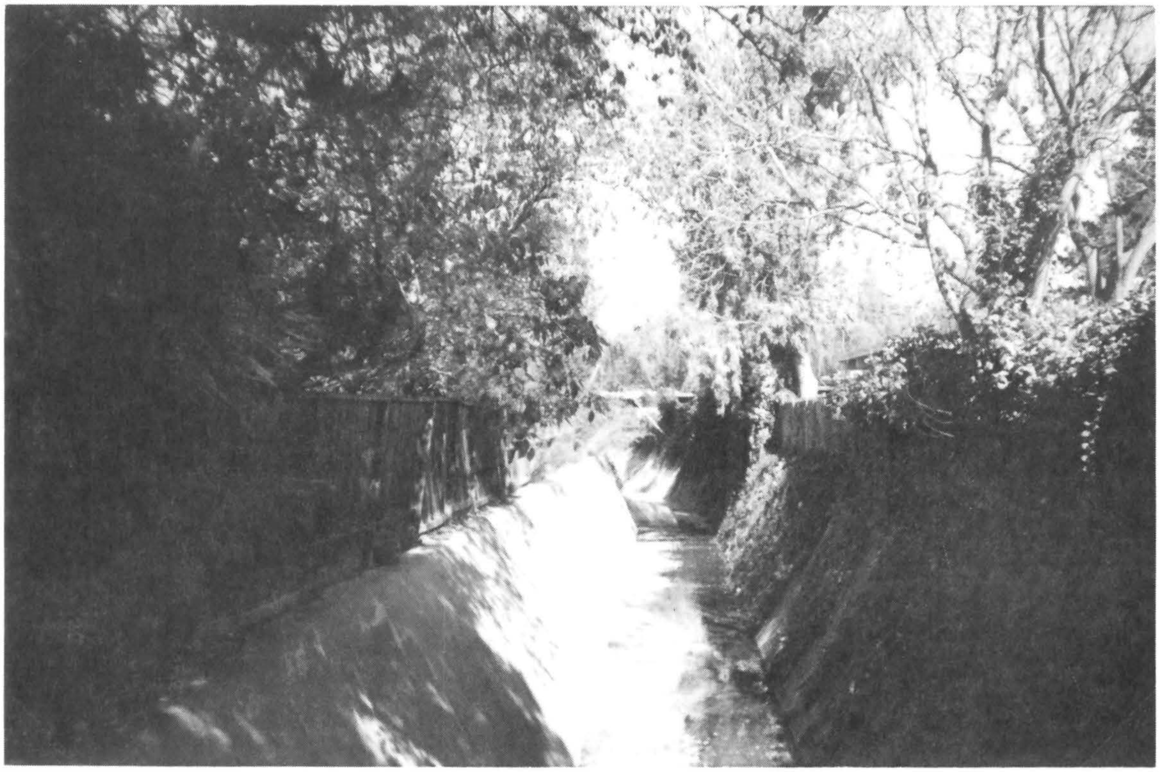


**PHOTO 2** was taken looking downstream from the footbridge over Adobe Creek between Duncan Place and Creekside Drive. Backyard fences are located along the top of both channel banks with mature trees and landscaping growing in the backyards adjacent to the fences.

PHOTOS 1 AND 2

**PHOTO 3** was taken looking upstream from near the Southern Pacific railroad culvert. Along this reach of the channel, the concrete walls are less steeply sloping. Wire cyclone fencing and mature trees lie adjacent to the top of the channel walls.

**PHOTO 4** was taken from inside the channel and shows the footbridge over the channel between Duncan Place and Creekside Drive. The mature trees extend over the channel from the adjacent backyards.

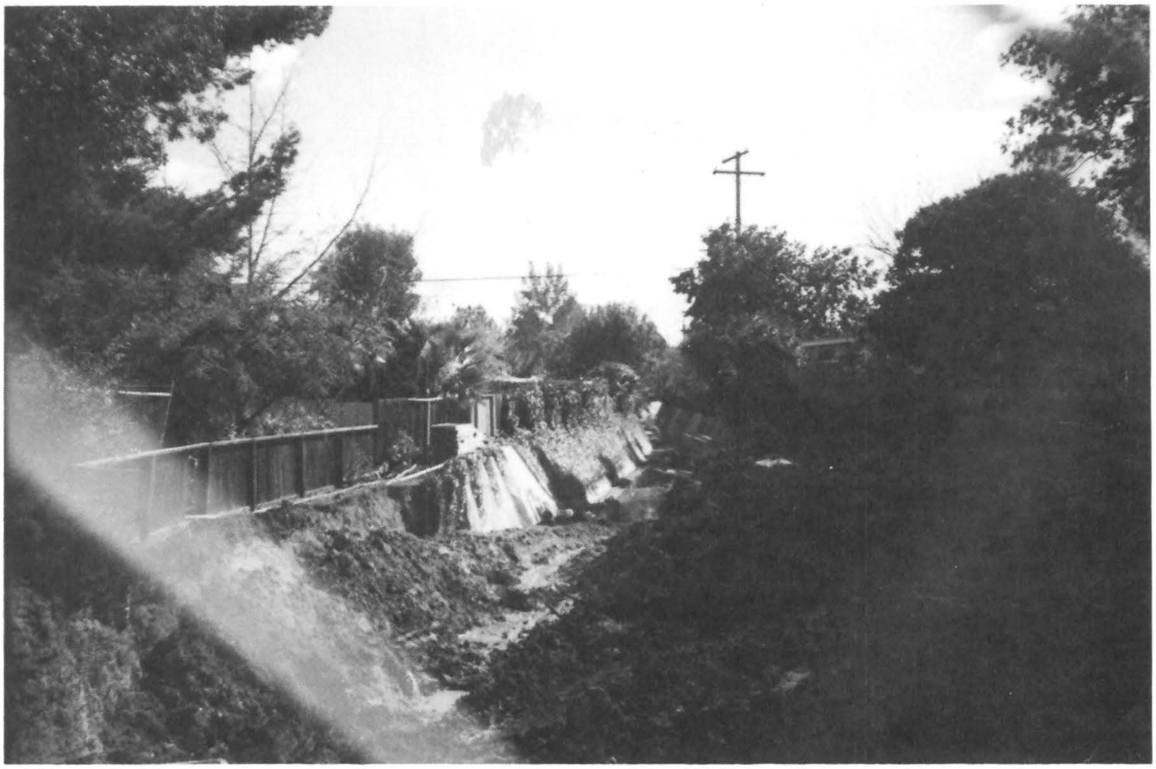


**PHOTO 5** was taken from the new Charleston Road bridge looking upstream. This photo shows the construction of a short section of the channel upstream of the bridge that provides a transition between the widened downstream channel and the existing channel upstream of Charleston Road.

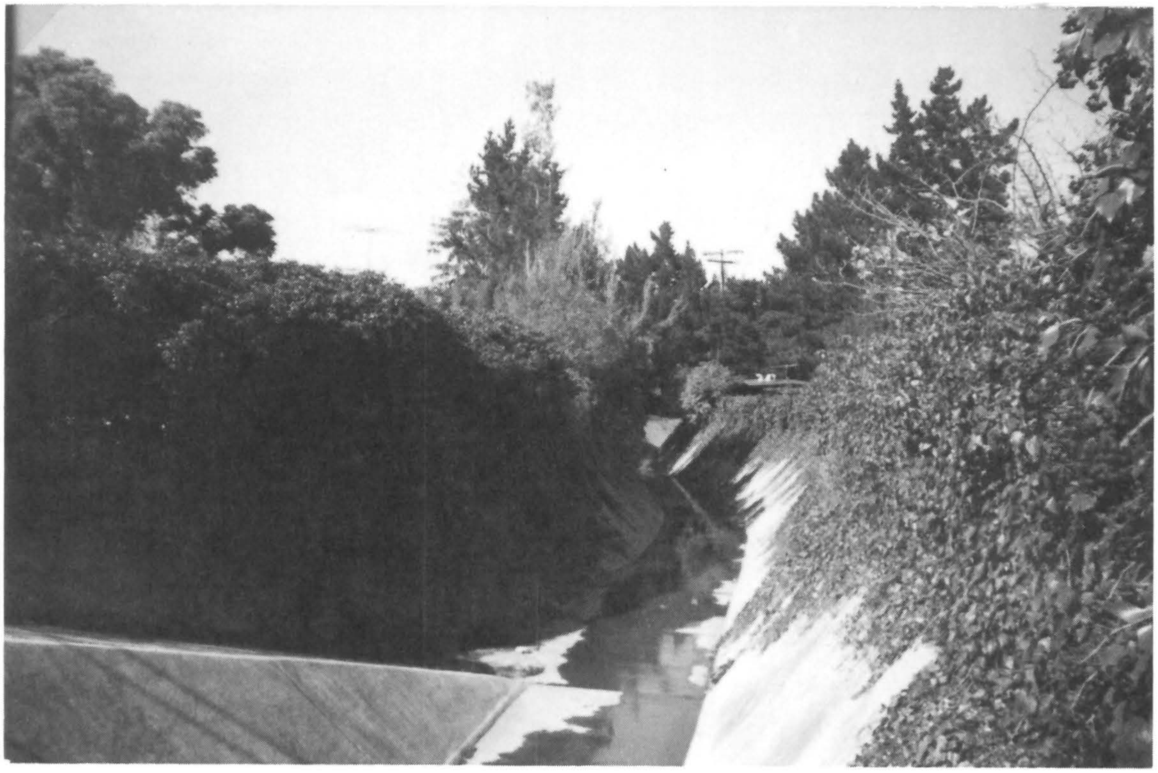


**PHOTO 6** was taken looking downstream from the Alma Street Bridge. The maintenance access ramp can be seen on the lower left side of the photo. The photo also shows the dense vegetation covering fences adjacent to the top of the channel.

PHOTOS 5 AND 6

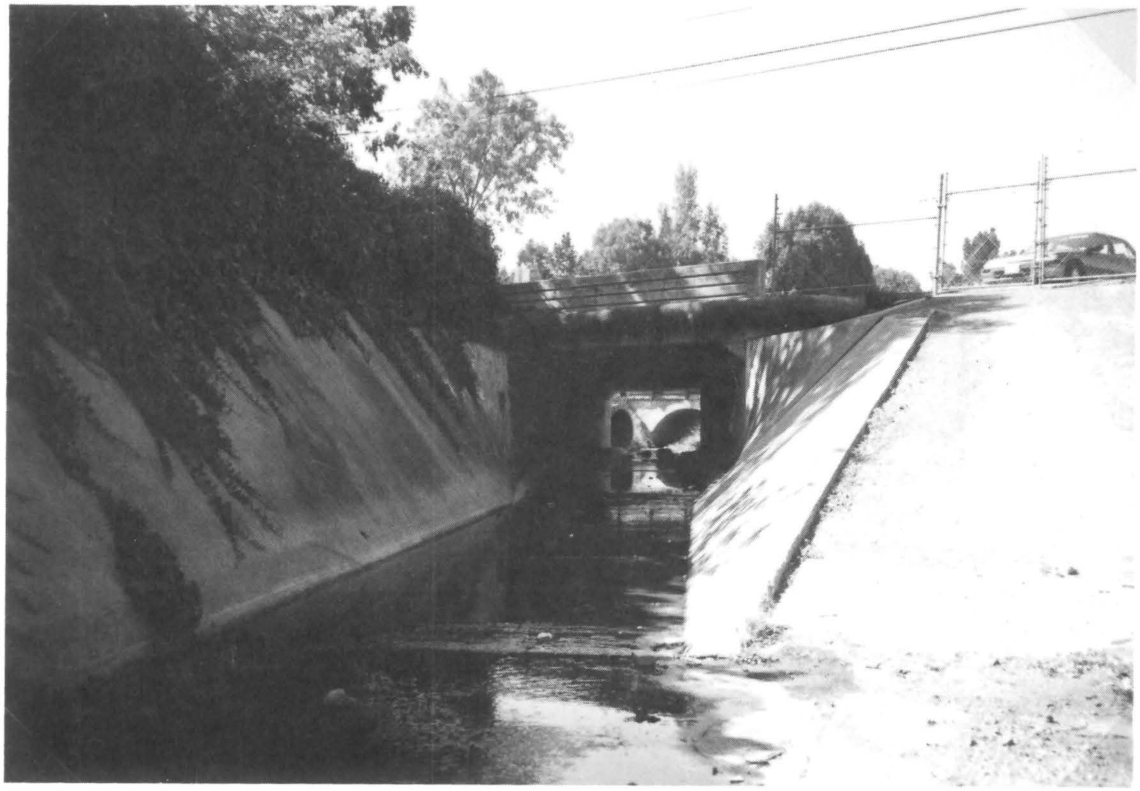


**PHOTO 7** was taken from within the channel looking upstream toward the Alma Street bridge. The Alma Street maintenance access ramp can be seen on the right side of the photo. The Southern Pacific railroad culvert can be seen in the center of the photo underneath the Alma Street bridge.

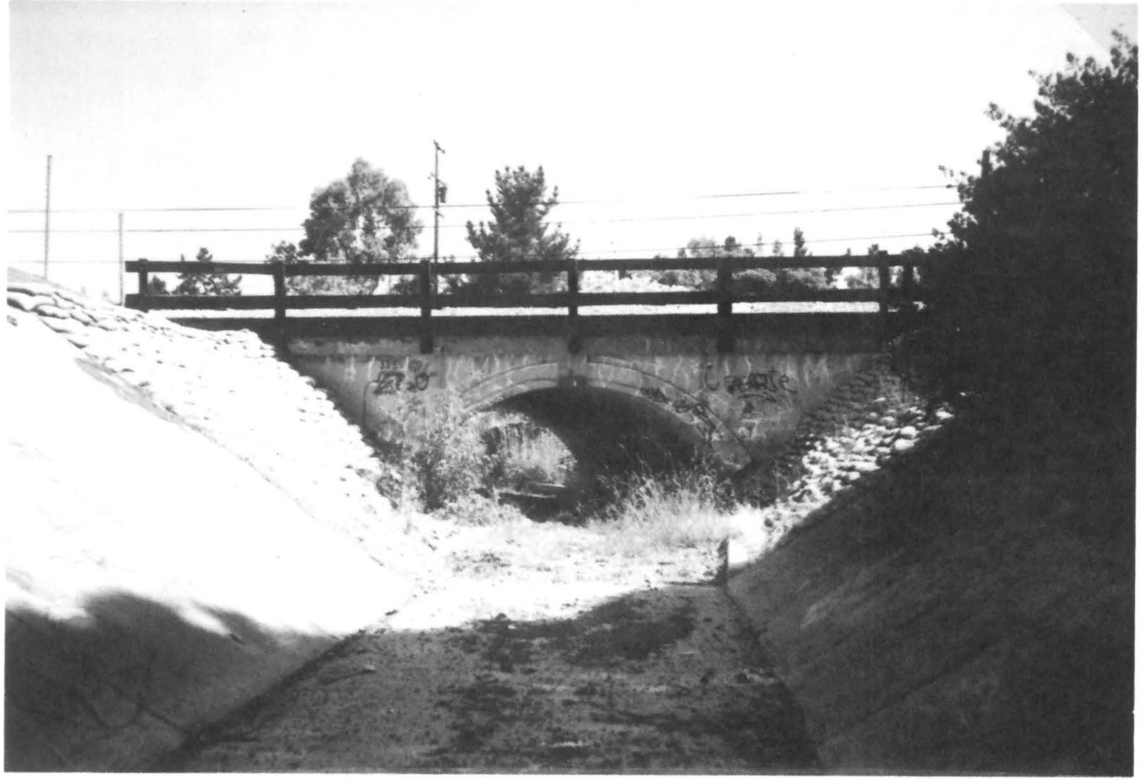


**PHOTO 8** was taken the bottom of the channel looking downstream at the Southern Pacific railroad culvert. Sacks of concrete can be seen protecting the channel next to the railroad bridge. The overhead utilities along the railroad tracks are visible above the railroad culvert.

PHOTOS 7 AND 8

## TABLE 4

## PROPOSED CHANNEL WALL HEIGHTS
### Above Adjacent Ground

| Station[1] (Feet) | West Bank Residents | East Bank Residents | Wall Height (Feet) |
|---|---|---|---|
| 196+86 | Begin Project Upstream of Charleston Road | | 2.2 |
| 197+17 | Ahrens | Downs | 2.0 |
| | Kirkeby | Justice | |
| | Liang | Becker | |
| | | Golden | |
| 200+05 | Liang | Golden | 2.8 |
| | Lobato | Kadis | |
| | Lubow | Dessain | |
| | | Wheeler | |
| 201+57 | Lubow | Wheeler | 3.8 |
| | Schnitzer | Heller | |
| 202+08 | Schnitzer | Heller | 4.4 |
| | Dau | Thompson | |
| | Collins | Lindholm | |
| | Johnson | Wang | |
| | Fung | | |
| 204+65 | Fung | Wang | 3.8 |
| | | Boehrs | |
| 205+22 | Fung | Boehrs | 4.0 |
| | Putnum | Morris | |
| 205+85 | Putnum | Morris | 4.0 |
| 206+18 | Putnum | Morris | |
| | Preston | Olmstead | |
| | Kyle | Barnes | |
| | | Porter | |
| 208+25 | Footbridge Crossing | | 2.8 |
| | Morrison | Fay | |
| | | Wall | |

Continued

---

[1] Numbers correspond with station numbers on project plans (on file with SCVWD).

## TABLE 4

## PROPOSED CHANNEL WALL HEIGHTS
### Above Adjacent Ground
### (Continued)

| Station[1] (Feet) | West Bank Residents | East Bank Residents | Wall Height (Feet) |
|---|---|---|---|
| 209+34 | City of Palo Alto<br>Grandburg | Wall<br>Haines | 2.0 |
| 209+73 | Grandburg<br>Tincher | Haines<br>Van De Riet | 2.1 |
| 210+94 | Tincher | Berwald | 4.9 |
| 211+10 | Tincher<br>Staehnke | Berwald | 4.8 |
| 211+20 | Staehnke | Berwald<br>Brann | 4.8 |
| 211+74 | Staehnke | Brann | 4.9 |
| 212+10 | Staehnke | Brann | 4.7 |
| 212+42 | Berg<br>Schmitz | Palmer<br>Wagner | 3.6 |
| 213+51 | Schmitz | Wagner<br>Shapero | 3.9 |
| 214+09 | Schmitz<br>Hart<br>Glauz<br>Norberg | Shapero<br>Okner<br>Gilbarg<br>Tilton | 3.8 |
| 216+10 | Norberg<br>Elspas | Tilton<br>Tao | 2.8 |
| 217+06 | Elspas<br>Drapkin | Tao<br>Tract 4927 | 3.2<br>3.2 |
| 218+08 | Drapkin | Tract 4927 | 3.4 |

---

[1] Correspond to station numbers on project plans (on file with SCVWD).

The privacy of backyards adjacent to the footbridge could be protected by construction of a screening fence along the length of the footbridge (and its approaches) of adequate height to block views into backyards. This impact can be mitigated to a nonsignificant level. However, the overall visual impacts from the removal of trees and vegetation and the construction of the channel walls would be significant and unavoidable.

## F. CULTURAL RESOURCES

### 1. Setting

An archaeological investigation of the site was conducted by Archaeological Resource Management in 1988. This investigation included an archival search of recorded archaeological sites, and a visual inspection along the creek channel and adjacent backyards where the ground was not covered by pavement, buildings or groundcover landscaping. This investigation revealed the presence of a prehistoric archaeological site located along the Adobe Creek channel that has been designated CA-SCl-600. In addition to inspection of the ground surface, the investigation included the excavation of several auger borings within the project area portion of CA-SCI-600. The results of this survey indicated that a significant prehistoric deposit is located within portions of the proposed project.

### 2. Impacts

Construction activities along the creek channel could have a potentially significant impact to the prehistoric cultural site. Potential impacts would result from disturbance of cultural materials by removal of the concrete channel lining, installation of a shoring system, and excavation for new channel forms and construction. Disturbance of cultural materials could also have a potential cultural impact because of the ancestoral and spiritual significance of the site to Native Americans.

### 3. Mitigation

Potential impacts to the prehistoric cultural resources would be mitigated by monitoring of construction activities in the vicinity of this site by a qualified archaeological monitor. If significant cultural materials are encountered during construction, an archaeologist and Native American should make further recommendations for the proper removal, study, reporting, and possible reburial of the materials. If human remains are encountered, the County Coroner should be notified and consulted.

# SECTION III

# ALTERNATIVES TO THE PROPOSED PROJECT

## INTRODUCTION

The SCVWD analyzed several flood control alternatives in addition to the proposed project. A full description of these alternatives is included in Appendix E. The impacts of each of these alternatives is described below and compared to the proposed project. Table 5 shows a comparison of the impacts and costs of each of the project alternatives. Compared to the alternatives considered, the proposed project would have the fewest environmental impacts, and is, therefore, the environmentally preferable alternative.

## A. NO PROJECT ALTERNATIVE

The "No Project" alternative consists of maintaining the existing concrete trapezoidal channel, without the construction of any channel improvements upstream of Charleston Road. The No Project alternative would perpetuate the existing flood hazards of Adobe Creek. Under this scenario, some level of flooding could be expected to occur an average of once every three years. The SCVWD would continue its ongoing maintenance program of debris and sediment removal, erosion repair, and fence repair. During a one percent (100-year) flood, damages to over 1,300 homes and apartments and 57 commercial and industrial buildings would occur from inundation by floodwaters from Adobe Creek. Flood damages during the one percent (100-year) storm could be as high as $30 million.

The No Project alternative would eliminate the short-term construction impacts of the proposed project and the visual impacts resulting from installation of channel walls extending up to five feet high at some locations. In addition, any potential loss of privacy would be avoided in the four backyards adjacent to the pedestrian footbridge which the project proposes to elevate. The No Project alternative, however, does not solve the existing flooding problems on Adobe Creek, and residents and businesses would continue to be subject to potential flooding hazards.

### Conclusion

The No Project alternative would perpetuate the existing flooding hazards along Adobe Creek and would, therefore, result in greater impacts than the proposed project.

## B. FLOODWALLS WITH 17 FOOT U-FRAME

### Description of Improvements

This alternative consists of constructing floodwalls to a maximum of 9.2 feet high along the top of the banks of the existing trapezoidal channel from Charleston Road to a point approximately 1,600 feet upstream. A 17 foot wide U-frame channel would replace the existing trapezoidal channel along the remaining approximately 1,500 feet. This alternative would also include replacement of the Southern Pacific (SP) railroad culvert and modifications of the Alma Street bridge.

# TABLE 5

## COMPARISION OF PROJECT ALTERNATIVE IMPACTS

| ISSUE | 17'/20' U-FRAME* | NO PROJECT | FLOODWALLS/ 17' U-FRAME | BYPASS | UPSTREAM STORAGE | DIVERSION |
|---|---|---|---|---|---|---|
| 1) PROJECT COST | $5.8 million | $3.1 million/yr or $30 million in 1% flood | $4 million | $12 million | $30-$40 million | $49 million |
| 2) GENERAL DESCRIPTION | Replace channel between Charleston & 800' u/s of SP line; replace SP culvert & modify Alma bridge | Flooding would continue | Install floodwalls for 1600' u/s of Charleston; replace rest of channel & culverts with 17'/20' U-frame | Install RCB along Alma to Charleston, and along Charleston to Adobe Creek | Store portion or all of excess channel flow in reservoir upstream | Divert excess flow to Matadero Creek & upgrade Matadero Creek channel |
| 3) ENVIRONMENTAL IMPACTS: | | | | | | |
| A) LOCAL DRAINAGE | No significant change in local storm drainage | No change in local storm drainage | Severely impacted due to water surface well above ground | No change in local storm drainage | No change in local storm drainage | No change in local storm drainage |
| B) ROADS & BRIDGES | See above | None | See above | Extreme construction impact on Charleston; replace Charleston bridge | Depends upon reservoir site | Replace most bridges on Matadero |
| C) UTILITIES | Minor impacts | None | Minor impacts | Major utility relocation crossing Alma & on Charleston | Depends upon reservoir site | Significant impacts |
| D) TRAFFIC | Minor impacts | None | Minor impacts | Significant impacts | Significant impacts | Significant impacts |
| E) RIGHT of WAY | No additional r/w | No additional r/w | No additional r/w | Additional r/w needed for SP line and elsewhere | 20-70 acres needed | Additional r/w needed from Alta Mesa cemetery |

*Proposed project

(Continued)

# TABLE 5

## COMPARISION OF PROJECT ALTERNATIVE IMPACTS (continued)

| ISSUE | 17'/20' U-FRAME* | NO PROJECT | FLOODWALLS/ 17' U-FRAME | BYPASS | UPSTREAM STORAGE | DIVERSION |
|---|---|---|---|---|---|---|
| F) NOISE & DUST | Significant from construction | None | Significant from construction | Significant from construction | Significant from construction | Significant from construction |
| G) VISUAL | Minor from channel walls; significant from vegetation loss | None | Significant from 9' floodwalls | None | Significant from floodwalls, reservoirs | Significant from 6' floodwalls |
| H) VEGETATION & WILDLIFE | Minor | None | Minor | Removal of mature trees on Alma Street | Significant removal of riparian habitat for reservoir construction | Significant removal of riparian habitat |
| I) ADJACENT STRUCTURES | Possible damage from construction | Possible damage due to flooding | Possible damage from construction | None | Possible damage from construction | Possible damage from construction |
| J) OTHER | Disturbance of cultural resources | Continued flooding | Unstable water surface | Ground disturbance at Palo Alto Senior Housing Project | Dynamite blasting & substantial excavation for reservoirs; relocation of homeowners and/or facilities; turbidity in Adobe Creek | Substantial excavation; loss of creek accesses; possible exposure of contaminated groundwater or soils; tubidity in Adobe Creek |

* Proposed project

### Description of Impacts

This alternative would result in generally similar short-term construction impacts in the surrounding neighborhood as the proposed project. Construction activities would create temporary noise and dust. However, noise impacts would be less severe for the approximately 1,600 feet upstream of Charleston Road because the channel lining would not be removed (with a jackhammer) and shoring/bracing systems and forms for new channel walls would not be required. During construction, backyard fences and vegetation would be removed.

Construction vehicle access into the creek would result in temporary traffic impacts on Alma Street and Charleston Road. As with the proposed project, installation of the U-frame channel could result in damage to neighboring structures, including slab floor heating systems, pools, and other structures near the creek channel. In addition, this alternative would make the footbridge between Duncan Place and Creekside Drive inaccessible during construction, similar to the proposed project.

The 9.2 foot floodwalls for this alternative would result in far greater visual impacts (from adjacent backyards) than the proposed project. These floodwalls would also result in significant local drainage impacts by obstructing surface drainage from discharging directly into the channel.

Other long-term impacts of this alternative include a very high, unstable water surface within the creek channel. As with the proposed project, the new, heightened footbridge would invade the privacy of neighboring yards, requiring heightening of backyard fences to provide screening.

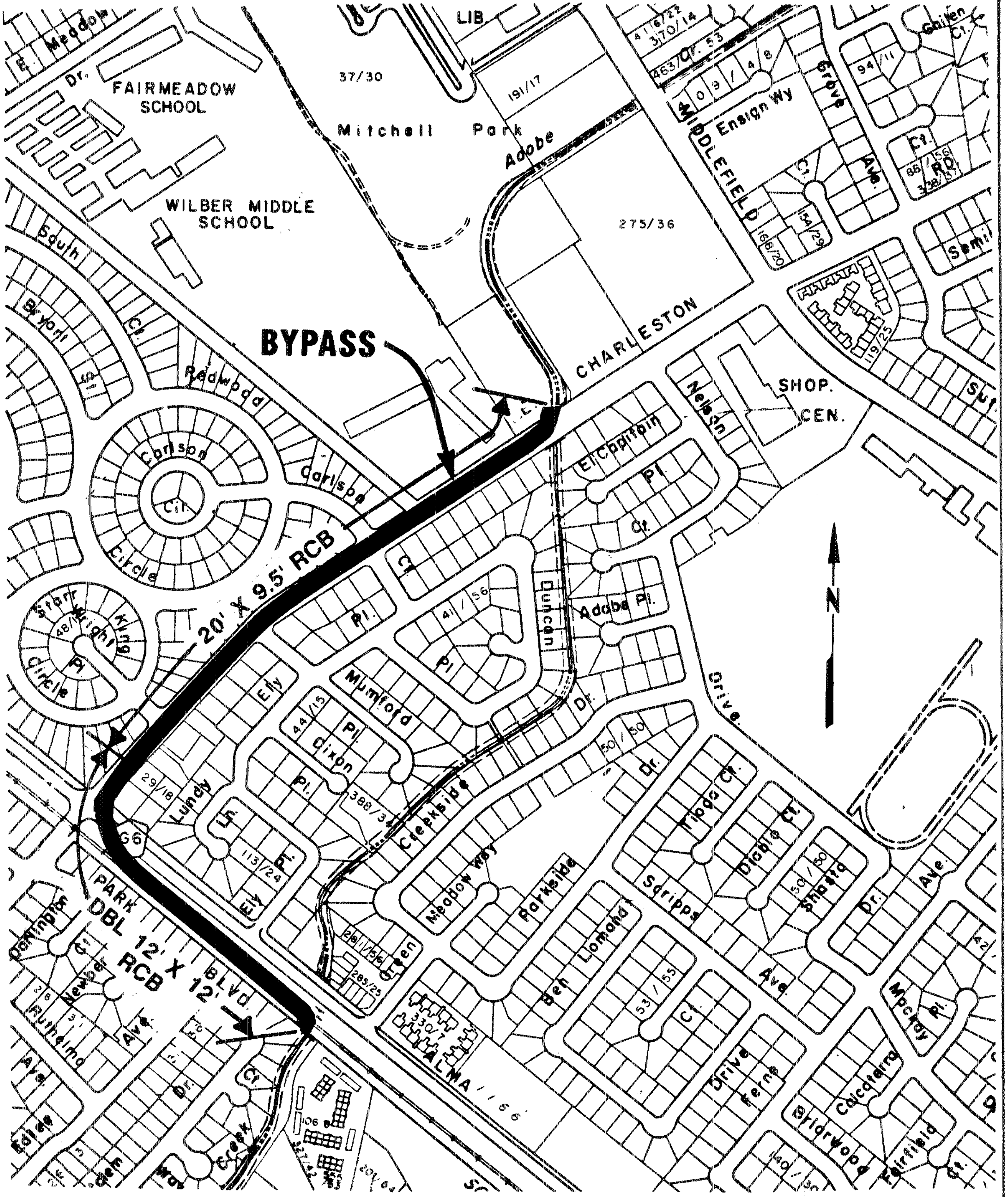
### Conclusion

This alternative would result in similar construction impacts to the proposed project, but would have greater visual impacts due to the approximately nine foot floodwalls. In addition, this alternative would create an unstable water surface within the channel. This alternative would have greater impacts than the proposed project.

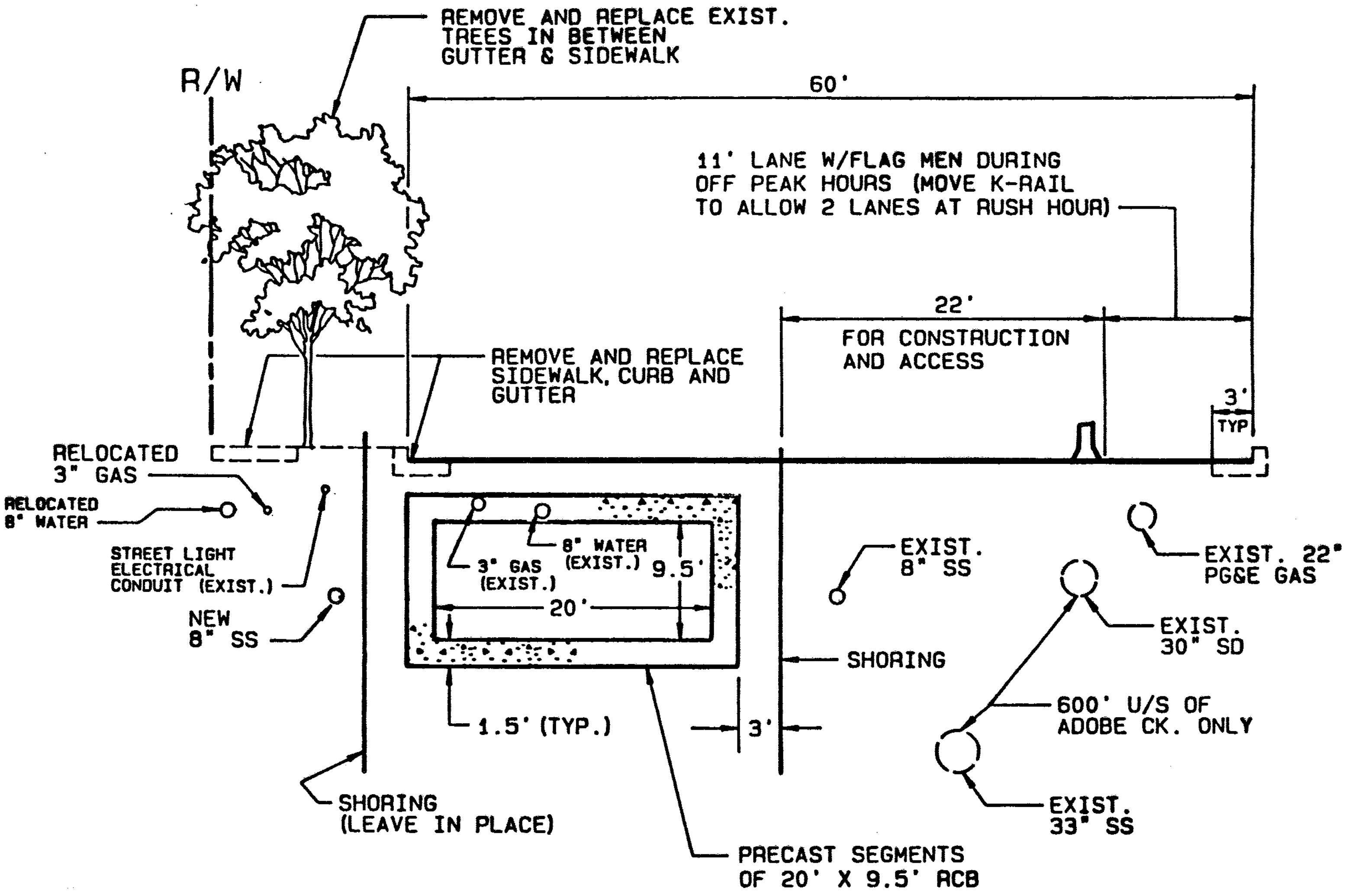
## C. ADOBE CREEK BYPASS

### Description of Improvements

The Adobe Creek Bypass alternative consists of the construction of a bypass between the SP railroad tracks and Charleston Road, with sufficient capacity to eliminate the need for improvements to this section of the Adobe Creek channel. The Bypass alternative would extend along the SP right-of-way to Charleston Road, across Alma Street, then along Charleston Road to Adobe Creek (see Figure 11). The upper reach of the bypass would consist of 1,300 feet of culvert extending from Charleston Road to the SP railroad culvert installed between the SP railroad tracks and Alma Street. The next 2,000 feet of culvert would be installed along the eastern side of Charleston Road from Alma Street to Adobe Creek. The culvert would consist of a rectangular box culvert of varying size to meet the constraints of the bypass site. A double 12 foot by 12 foot box culvert could be used to along Alma street as shown on Figure 12 and a 20 foot by 9.5 foot box culvert could be used along Charleston Road as shown on Figure 13. The northern, or downstream, half of



LOCATION OF ADOBE CREEK BYPASS ALTERNATIVE FIGURE 11



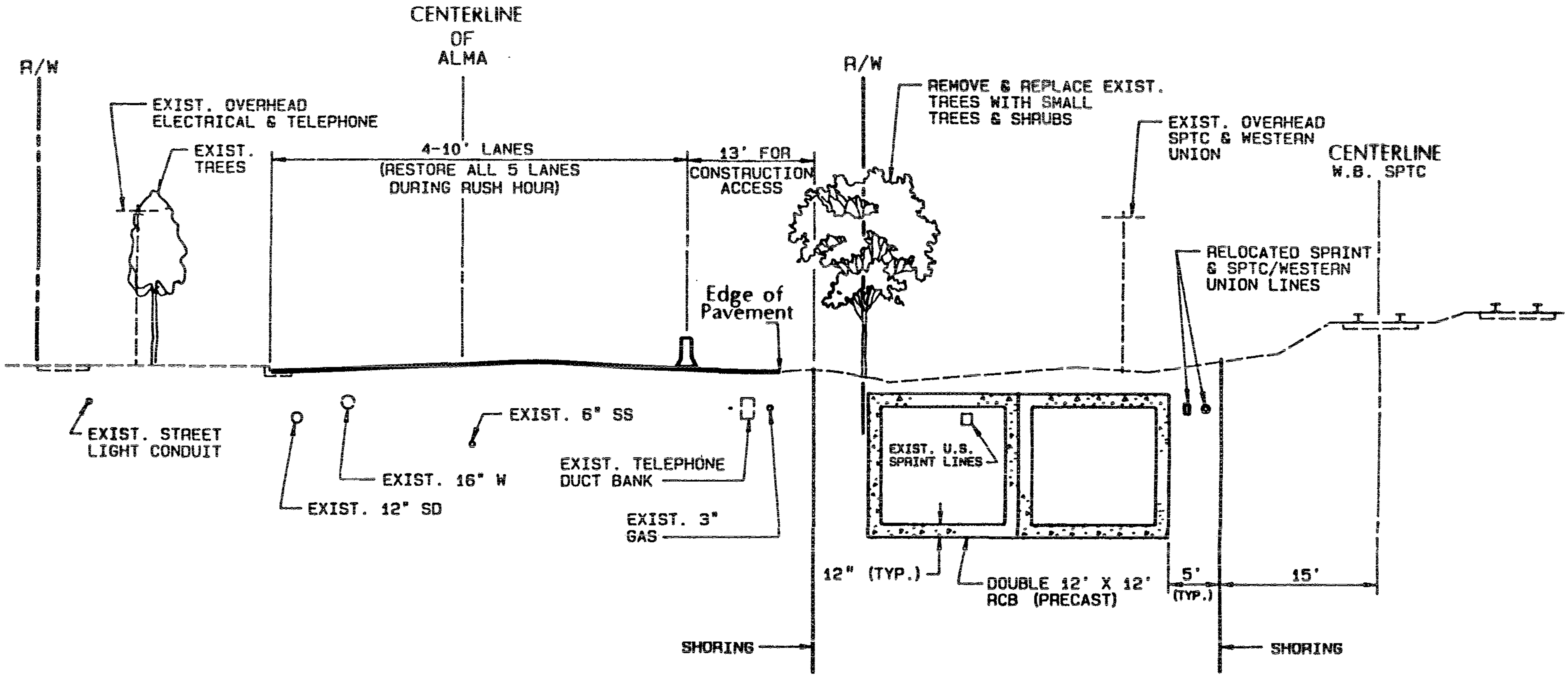
SS = Sanitary Sewer

SD = Storm Drain

RCB = Reinforced Concrete Box

TYPICAL CROSS-SECTION DURING CONSTRUCTION - CHARLESTON ROAD

FIGURE 12


CENTERLINE OF ALMA
R/W
EXIST. OVERHEAD ELECTRICAL & TELEPHONE
EXIST. TREES
4-10' LANES (RESTORE ALL 5 LANES DURING RUSH HOUR)
13' FOR CONSTRUCTION ACCESS
Edge of Pavement
R/W
REMOVE & REPLACE EXIST. TREES WITH SMALL TREES & SHRUBS
EXIST. OVERHEAD SPTC & WESTERN UNION
CENTERLINE W.B. SPTC
RELOCATED SPRINT & SPTC/WESTERN UNION LINES
EXIST. STREET LIGHT CONDUIT
EXIST. 6" SS
EXIST. 16" W
EXIST. 12" SD
EXIST. TELEPHONE DUCT BANK
EXIST. 3" GAS
EXIST. U.S. SPRINT LINES
12" (TYP.)
DOUBLE 12' X 12' RCB (PRECAST)
5' (TYP.)
15'
SHORING
SHORING

SS = Sanitary Sewer

SD = Storm Drain

RCB = Reinforced Concrete Box

TYPICAL CROSS-SECTION DURING CONSTRUCTION -
ALONG ALMA STREET FROM ADOBE CREEK TO CHARLESTON ROAD

FIGURE 13

the Charleston Road bridge would be reconstructed to connect the box culvert back into the Adobe Creek channel.

## Description of Impacts

This alternative would result in substantially greater short-term construction impacts than the proposed project. The short-term impacts of this alternative are as follows:

1. Box culvert placement would require removal of existing mature trees along Alma Street between Adobe Creek and Charleston Road. (These trees would be replaced with smaller-rooted species to avoid damage to the culvert.)

2. Construction on the box culvert along Alma Street would require relocation of Sprint and Western Union lines as shown on Figure 13. Construction of the box culvert across Alma Street near the Charleston Road intersection would require the removal and relocation of an existing three inch gas line, telephone duct bank and eight inch sanitary sewer line. Box culvert construction along Charleston Road would require the removal and relocation of a three inch gas line and eight inch water line as shown in Figure 12. Installation of the box culvert would require construction of an new eight inch sanitary sewer line along the easterly side of the street as shown on Figure 12. This new eight inch sanitary line is required since the lateral connections from the homes along the easterly side of the street could not be connected to the existing eight sanitary line located near the center of the street (refer to Figure 12). The street light electrical conduit on the easterly side of the street would have to be removed and replaced for construction of the new eight inch sanitary sewer line. Relocation of these utilities would require the removal and replacement of the existing sidewalk and vegetation along the eastern side of Charleston Road.

   A 22" gas line on Charleston would have to be relocated at the confluence with Adobe Creek.

3. The Adobe Creek Bypass alternative would result in significant traffic impacts during construction. Construction near the intersection of Alma and Charleston Road would significantly degrade traffic conditions in this area. Open cutting on the Alma Street crossing would severely impact this intersection. (The City of Palo Alto has indicated that only one lane at a time on Alma Street could be closed during this construction.) To allow for construction of the culvert on Charleston Road, traffic on this street would have to be restricted to only one lane (as shown on Figure 13) with flagpersons during the hours of 9 AM to 4 PM. Southbound and northbound traffic on Charleston Road would be stopped and allowed to proceed alternately. This would result in impacts to vehicle access to the driveways on this portion of Charleston. Pedestrian and bicycle traffic on Charleston would also be impacted during sidewalk reconstruction. Construction of the box culvert along Alma Street would also result in traffic impacts along this street.

   The downstream (western) half of the Charleston Road bridge would have to be rebuilt, resulting in additional traffic impacts in this area.

4. Installment of a culvert on the Palo Alto Senior Housing Project property would require removal and replacement of existing walkways and vegetation. An easement would have to be obtained for crossing this property. In addition, an easement would have to be obtained to cross the front yard of the residence located at the northeast corner of Alma and Charleston.

5. The residents along Alma Street and Charleston Road would be subject to temporary noise, dust, air quality, and public safety impacts.

The long-term visual impacts of the bypass alternative would be less than the proposed project because there would not be an exposed channel or walls. The long-term impacts of the bypass alternative would include the removal of mature trees on Alma Street. The culverts constructed on portions of the Palo Alto Senior Housing Project property and the residential property on the northeast corner of Alma and Charleston would preclude the replanting of vegetation on these areas. In addition, the future repair/replacement of utilities relocated under the sidewalk on the eastern side of Charleston would result in greater impacts on the adjacent homes.

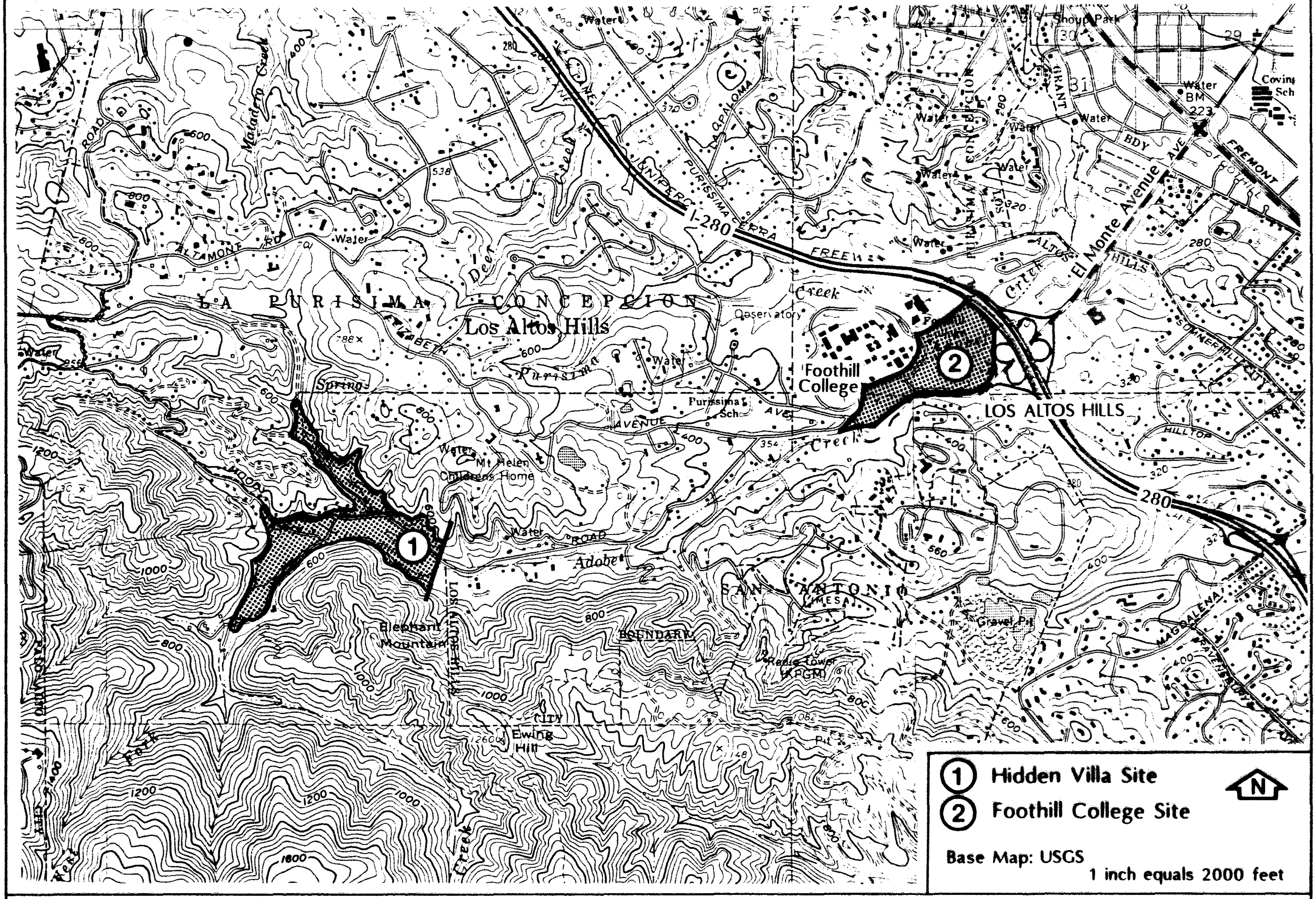
### Conclusion

This alternative would result in significant impacts to traffic circulation, access to adjacent homes on Charleston Road, relocation of utilities, reconstruction of the Charleston Road bridge, and acquisition of additional right-of-way. Therefore, this alternative would have substantially greater impacts than the proposed project.

## D. UPSTREAM STORAGE ALTERNATIVE

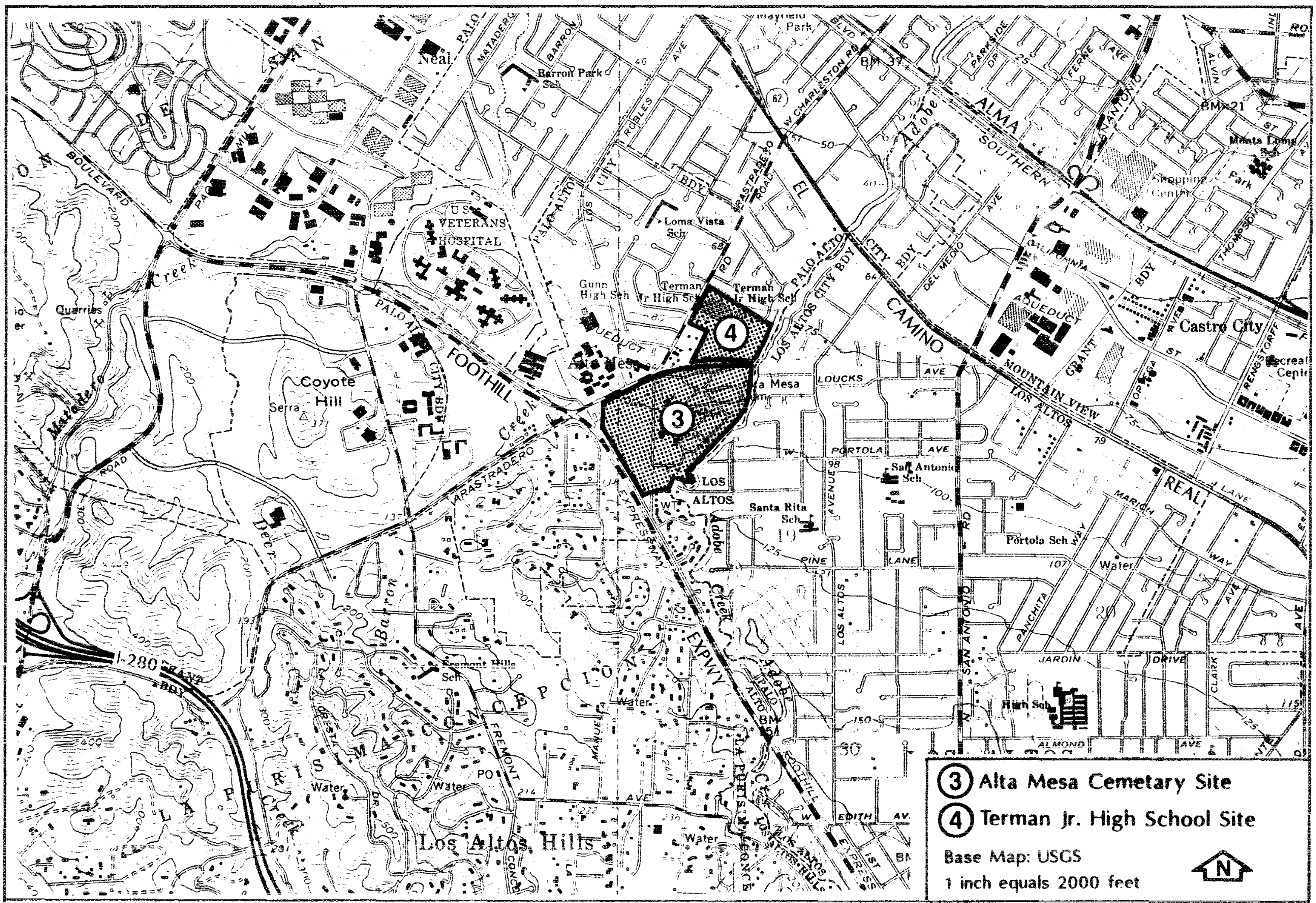
The Upstream Storage alternative consists of constructing an upstream reservoir to detain peak storm flows in order to reduce the extent of the proposed Adobe Creek channel improvements. The existing capacity of the Adobe Creek channel between Alma Street and Charleston Road is 1,200 cfs (cubic feet per second) and allowing for adequate freeboard, the SCVWD has calculated that the acceptable flow is 700 cfs. The SCVWD investigated possible upstream storage sites and identified four locations. None of the storage sites would have adequate capacity to fully reduce the flows within the existing Adobe Creek channel. Therefore, lower floodwalls along Adobe Creek between Alma Street and Charleston Road would be required under any of the four possible upstream storage site scenarios.

The following four storage sites have been considered, based upon available open space: 1) Hidden Villa, 2) Foothill College, 3) Alta Mesa Cemetery, and 4) Terman Junior High. The locations of the four storage sites are shown on Figures 14 and 15. A combination of these sites is addressed later in section "F. OTHER ALTERNATIVES". The primary impacts of each of the four storage sites is described below under their respective names.



POSSIBLE RESERVOIR SITES FOR UPSTREAM STORAGE ALTERNATIVE

FIGURE 14



POSSIBLE RESERVOIR SITES FOR UPSTREAM STORAGE ALTERNATIVE

FIGURE 15

1. Hidden Villa

### Description of Improvements

The Hidden Villa storage facility would be located along Moody Road above Murietta Lane. The Hidden Villa storage facility would require the acquisition of approximately 70 acres of right-of-way and construction of a 90 foot high dam across Adobe Creek channel, as shown on Figure 14. 3,000 feet of Moody Road and 1,000 feet of Moody Court would require relocation since the existing Moody Road would be inundated (beneath the reservoir). Adobe Creek channel improvements would include replacement of the SP railroad culvert and construction of floodwalls along the top of the existing channel between Alma Street and Charleston Road.

### Description of Impacts

Construction of the floodwalls and replacement of the SP railroad bridge would result in generally similar impacts to the proposed project. Backyards fences would be removed and backyard landscaping and improvements disturbed while the floodwalls are constructed. Construction noise and dust would be somewhat less since the existing concrete channel lining would not be demolished (with a jackhammer) and removed. The SP railroad culvert replacement would result in temporary relocation of the tracks closer to Alma Street, requiring possible removal of trees along the south side of Alma Street. Construction traffic into the Adobe Creek channel from Alma Street and Charleston Road would impact traffic on these streets. Pedestrian traffic would also be affected since the footbridge between Duncan Place and Creekside Way would be out of service during floodwall construction. The floodwalls may create visual impacts upon the backyards along the creek channel, depending upon floodwall height.

In addition to the above impacts which are similar to the proposed project, the Hidden Villa storage facility alternative would result in several substantial impacts from construction of the reservoir. These would include the following short-term impacts:

1. Dynamite blasting would be required to excavate the dam area of the reservoir.

2. Traffic detours and delays, and degradation of emergency and utility services (to Moody Road area) would occur during relocation and reconstruction of Moody Road.

3. During and after construction, there would be increased turbidity in Adobe Creek below the dam site.

This alternative would also have the following long-term impacts:

1. Visual impacts would result from the relocation of approximately 3000 feet of Moody Road and 1000 feet of Moody Court (including utilities).

2. At least seven homeowners would be impacted and relocated.

3 The reservoir would result in increased flooding at Hidden Villa and Los Altos Hills open space areas.

4. The reservoir and Moody Road relocation would result in substantial loss of vegetation and wildlife habitat.

2. Foothill College

### Description of Improvements

The Foothill College storage site is located at Foothill College above Highway 280, as shown on Figure 14. This storage facility would require extensive excavation, and the complete removal and relocation of the football/baseball fields and the eastern parking lots. Adobe Creek channel improvements would include replacement of the SP railroad culvert and partial channel replacement with floodwalls between Alma Street and Charleston Road.

### Description of Impacts

Construction of the floodwalls and replacement of the SP railroad bridge would result in generally similar impacts to the proposed project. The impacts similar to the proposed project are described above under the Hidden Villa storage site discussion. In addition to these impacts, the Foothill College storage facility alternative would result in several substantial impacts from construction of the reservoir. These would include the following short-term impacts:

1. Extensive excavation of at least 450,000 cubic yards of earth would be required. Blasting would also be required to remove rock, resulting in noise and air quality impacts to the surrounding area.

2. During and following construction there would be increased turbidity in Adobe Creek below the reservoir site.

In addition, this alternative would result in the following long-term impacts:

1. Construction of the reservior would require the removal of baseball fields, football fields, and tracks, severely impacting the operation of Foothill College, for which no alternative sites are available.

2. A concrete retaining wall at Foothill College would create visual impacts.

3. Alta Mesa Cemetery

### Description of Improvements

The Alta Mesa Cemetery storage site is located between Arastadero Road and Adobe Creek next to the Foothill Expressway, as shown on Figure 15. The Alta Mesa Cemetery storage facility would contain approximately 70 acres, and would not have any floodwalls at the reservoir. The Adobe Creek channel improvements would include replacement of the SP railroad culvert and partial channel replacement with floodwalls between Alma Street and Charleston Road.

### Description of Impacts

Construction of the floodwalls and replacement of the SP railroad culvert would result in generally similar impacts to the proposed project. The impacts are similar to the proposed project and have been described above under the Hidden Villa storage site discussion. In addition to these impacts, the Alta Mesa storage facility alternative would result in several substantial impacts from construction of the reservoir. The primary short-term impact would be the excavation of approximately 440,000 cubic yards of earth. In addition, this alternative storage site would result in the following significant long-term impacts:

1. Relocation of the existing cemetery burial sites would result in significant, unavoidable environmental impacts and social impacts.

2. Elimination of approximately 2,500 feet of riparian habitat would result from installation of the reservoir and spillway, resulting in significant, unavoidable environmental impacts upon vegetation and wildlife.

3. Sediment deposition in the reservoir, requiring periodic removal and maintenance.

4. Terman Junior High

### Description of Improvements

The Terman Junior High storage site alternative is located near the Terman Junior High School between Arastadero Road and Adobe Creek, immediately below the Alta Mesa Cemetery as shown on Figure 15. The Terman Junior High storage facility would require the acquisition of approximately 21.7 acres of right-of-way. Floodwalls several feet in height would be required between Alma Street and Charleston Road to provide adequate capacity.

### Description of Impacts

Construction of the floodwalls between Alma and Charleston would result in generally similar impacts to the proposed project as described previously. In addition to these impacts, the Terman Junior High storage facility alternative would result in several substantial impacts from construction of the reservoir. The short-term impacts are described as follows:

1. Construction would involve extensive ground disturbance (and truck traffic) resulting from the excavation of approximately 440,000 cubic yards of earth.

2. Possible removal of asbestos from existing school buildings would be required.

In addition, this alternative would result in the following long-term impacts:

1. Construction of the reservoir would require the removal (and possible relocation) of the existing junior high school, which is currently used as a library, community center, low income housing, and a park. This would result in local service, housing, and recreational impacts.
2. A floodwall (six feet maximum) on the lower sides of the reservoir would result in visual impacts.
3. Installation of a spillway would eliminate approximately 500 feet of riparian habitat, resulting in significant biological impacts.
4. Sediment deposition would occur within the reservoir, requiring periodic removal of sediment and vegetation.

### Conclusion

The upstream storage alternative would significantly impact all four of the possible storage (reservoir) sites. Construction of a reservoir on any of these sites would result in significant impacts to riparian habitat and existing land use. The channel improvements between Charleston Road and Alma Street would result in similar construction impacts as the proposed project. The upstream storage alternative would result in substantially greater impacts than the proposed project.

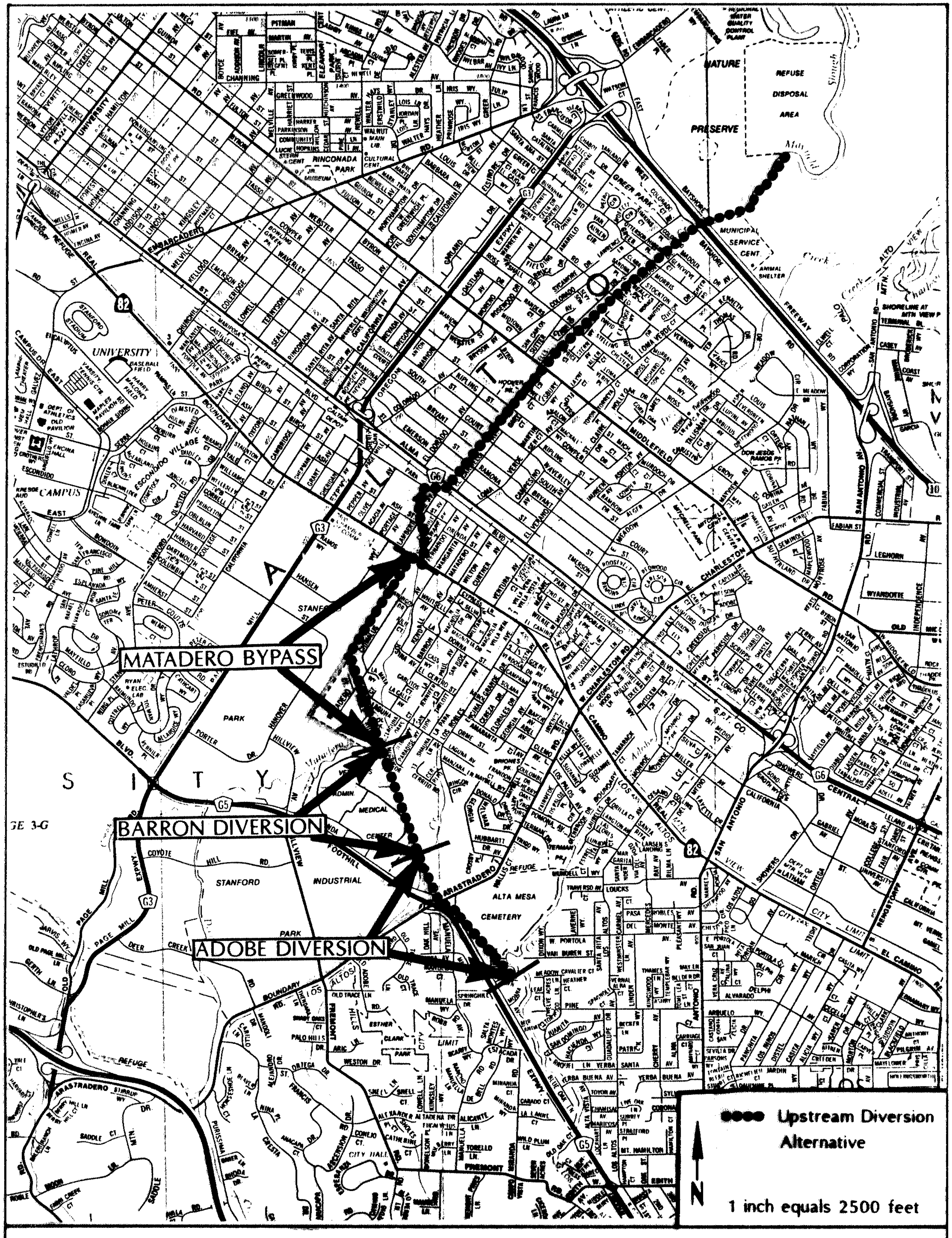
## E. ADOBE CREEK DIVERSION

### Description of Improvements

The Adobe Creek Diversion alternative consists of diverting a portion of the stormflows from Adobe Creek to Matadero Creek in order to limit flood control improvements on Adobe Creek between Alma Street and Charleston Road to floodwalls only.

The flows in excess of 1,915 cfs (see Appendix E) from Adobe Creek would be diverted at the upstream end of the Alta Mesa Cemetery. The location for the Adobe Creek Diversion alternative is shown on Figure 16. This diversion would pass through the southern edge of the Alta Mesa Cemetery, across Arastadero Road, and along Gunn High School to the Barron Creek Sediment Basin. From the Barron Creek Sediment Basin, the diversion would follow the Barron Diversion and Matadero Bypass to Matadero Creek at El Camino Real. Downstream of El Camino Real, the additional flows would be accommodated by increasing the existing Matadero Creek channel capacity. (Matadero Creek Engineer's Report, 1988).

The analysis of the Adobe Creek Diversion alternative is described beginning at the downstream end and proceeding upstream. This analysis is divided into separate channel reaches as follows:



LOCATION OF UPSTREAM DIVERSION ALTERNATIVE FIGURE 16

| | |
|---|---|
| Matadero Creek | - Palo Alto Flood Basin to Ross Road |
| | - Ross Road to Alma Street |
| | - Alma Street to El Camino Real |
| | - Upstream of El Camino Real |
| Matadero Bypass | - El Camino Real to Matadero Creek |
| Barron Diversion | - Matadero Creek to Barron Sediment Basin |
| Adobe Diversion | - Barron Sediment Basin to Adobe Creek |

1. Matadero Creek

### Description of Improvements

a. Palo Alto Flood Basin to Ross Road

The channel between Highway 101 and the Palo Alto Flood Basin would not be modified, although the channel at Highway 101 would require widening. The channel between Highway 101 and Ross Road is currently under construction and includes the installation of floodwalls and replacement of culverts. The floodwalls are a maximum of 4.5 feet high. However, the Diversion alternative would require enlargement of this reach of the channel.

The channel enlargement upstream of Highway 101 would consist of replacing the existing earth and concrete trapezoidal channel with a concrete U-frame channel. All culverts would also require widening to the width of the SCVWD right-of-way. Floodwall heights would be up to six feet tall.

b. Ross Road to Alma Street

The flood control improvements in this reach (presently under construction) consist of the installation of floodwalls, the removal and replacement of a section of channel, and the replacement of the existing culverts at Middlefield Road, Cowper Street, and Waverly Street. Several footbridges are also planned for construction. In order to accommodate the additional flows from Adobe Creek, the channel and culverts in this reach of the channel would have to be replaced and the footbridges raised.

c. Alma Street to El Camino Real

Improvements along this reach of Matadero Creek between Alma Street and El Camino Real would consist of channel removal and replacement with a 25 foot wide box culvert. In addition, improvements would include replacement of the culverts at the SP railroad tracks, Park Boulevard, and Lambert Street.

d. Immediately Upstream of El Camino Real

Improvements to this channel reach would consist of construction of floodwalls several feet high, extending upstream approximately 500 feet from El Camino Real.

### Description of Impacts

Construction of the Matadero Creek improvements described above would result in both long-term and short-term impacts, some of which are significant and unavoidable. Short-term impacts would include the following:

1) During construction, dust and high noise levels would be generated.

2) Possible vibrations due to pile driving (if used for shoring) could damage structures and affect nearby residences. Ground movement resulting from deflection of shoring could also cause structural damage.

3) Traffic impacts would occur on Louis Road, Greer Road, and Ross Road would result from construction traffic into Matadero Creek to work on the channel replacement and culvert modification.

4) Backyard fences and vegetation would be removed and there would be a general disturbance of backyards along the creek channel during construction.

The long-term impacts of the Matadero Creek improvements would include the following:

1) Channel improvements would result in the loss of riparian vegetation, including the removal of large mature native oaks. The replacement of the earthen channel with a concrete channel would reduce riparian habitat value.

2) Visual impacts would result from the construction of floodwalls, some of which would reach six feet or more in height.

3) Several existing driveway bridges and footbridges would have to be raised.

4) Construction of the new channel would result in the loss of several SCVWD access ramps and maintenance roads, thereby increasing the maintenance costs. In addition, a proposed City of Palo Alto bicycle path under Highway 101 would be eliminated.

| | |
|---|---|
| Matadero Creek | - Palo Alto Flood Basin to Ross Road |
| | - Ross Road to Alma Street |
| | - Alma Street to El Camino Real |
| | - Upstream of El Camino Real |
| Matadero Bypass | - El Camino Real to Matadero Creek |
| Barron Diversion | - Matadero Creek to Barron Sediment Basin |
| Adobe Diversion | - Barron Sediment Basin to Adobe Creek |

## 1. Matadero Creek

### Description of Improvements

#### a. Palo Alto Flood Basin to Ross Road

The channel between Highway 101 and the Palo Alto Flood Basin would not be modified, although the channel at Highway 101 would require widening. The channel between Highway 101 and Ross Road is currently under construction and includes the installation of floodwalls and replacement of culverts. The floodwalls are a maximum of 4.5 feet high. However, the Diversion alternative would require enlargement of this reach of the channel.

The channel enlargement upstream of Highway 101 would consist of replacing the existing earth and concrete trapezoidal channel with a concrete U-frame channel. All culverts would also require widening to the width of the SCVWD right-of-way. Floodwall heights would be up to six feet tall.

#### b. Ross Road to Alma Street

The flood control improvements in this reach (presently under construction) consist of the installation of floodwalls, the removal and replacement of a section of channel, and the replacement of the existing culverts at Middlefield Road, Cowper Street, and Waverly Street. Several footbridges are also planned for construction. In order to accommodate the additional flows from Adobe Creek, the channel and culverts in this reach of the channel would have to be replaced and the footbridges raised.

#### c. Alma Street to El Camino Real

Improvements along this reach of Matadero Creek between Alma Street and El Camino Real would consist of channel removal and replacement with a 25 foot wide box culvert. In addition, improvements would include replacement of the culverts at the SP railroad tracks, Park Boulevard, and Lambert Street.

between Matadero Creek and the Barron Sediment Basin with a 23 foot by eight foot box culvert.

### Description of Impacts

The short-term construction impacts along this channel reach would be increased due to the wider box culvert. These impacts would be as follows:

1. Noise and air quality impacts would result from construction activities.

2. Much of the vegetation within Bol Park would be removed and replaced with construction of the new culvert.

3. Construction within areas of possible soil and groundwater contamination located near Watkins-Johnsons could expose construction workers and property owners to toxic materials.

4. The bicycle path within the project area would have to be detoured, resulting in accessibility impacts.

The long-term impacts of this reach would include the following:

1. Revegetation would be limited to shallow rooting plants and shrubs above the 23 foot wide box culvert since deep rooting trees and shrubs could not be grown in the shallow soils above the box culvert.

2. Installation of the box culvert would result in substantial excavation, increasing construction traffic to and from the project site.

3. The wider box culvert would make installation and maintenance of utilities more difficult.

4. Adobe Creek Diversion (Barron Sediment Basin to Adobe Creek)

### Description of Improvements

Channel improvements along this reach would consist of the construction of a 13 foot by 12 foot box culvert between Adobe Creek and Barron Sediment Basin.

### Description of Impacts

The short-term impacts along this reach of the creek would be as follows:

1. Construction of improvements along this reach would create noise and dust impacts, which would affect nearby residences and students at Gunn High School.

2. The bicycle path between Arastadero Road and the Barron Sediment Basin would have to be detoured during construction, resulting in impacts to bicycle traffic in the area.

3. Much of the vegetation within Bol Park would be have to be removed and replaced to construct the proposed culvert.

4. Construction within areas of possible soil and groundwater contamination located near Fairchild could expose construction workers, property owners and the students and faculty of Gunn High School to toxic materials.

5. Construction of the Adobe Creek diversion structure would impact vegetation on Adobe Creek, and could potentially increase creek turbidity.

6. Traffic on Miranda Avenue may be impacted during installation of the box culvert within the Alta Mesa Cemetery. Construction of the culvert across Arastadero Road could also impact traffic on this street.

The most significant long-term impact along this reach would be the relocation of burial sites within the Alta Mesa Cemetery (next to Miranda Avenue).

### 5. Adobe Creek (Charleston Road to Alma Street)

#### Description of Improvements

Channel improvements to this reach would consist of the installation of low floodwalls between Alma Street and Charleston Road.

#### Description of Impacts

1. Noise and air quality impacts would result from construction activities between Alma Street and Charleston Road.

2. Traffic impacts on Alma Street and Charleston Road would result from construction traffic into Adobe Creek to install the floodwalls.

3. Backyard fences and vegetation would potentially be removed and replaced for construction of floodwalls.

4. The footbridge between Duncan Place and Creekside Way would be inaccessible for several months during floodwall installation.

5. The installation of floodwall foundations may result in damage to nearby structures, such as swimming pools, decks, etc.

The major long-term impacts along this reach would consist of visual impacts created by the construction of floodwalls several feet high between Alma Street and Charleston Road.

#### Conclusion

The Adobe Creek Diversion alternative would result in construction impacts similar to the proposed project from Charleston Road to Alma Street. This alternative would also create construction impacts along much of the diversion channel alignment. This alternative would impact riparian vegetation, (by replacing earthen channel with concrete lining), increase turbidity in Adobe Creek, eliminate channel accesses, impact traffic, and possibly expose workers and residents to contaminated groundwater or soils. The Diversion alternative would have substantially greater impacts than the proposed project.

## F. OTHER ALTERNATIVES

The SCVWD also investigated various combinations of the alternatives described above. Four possible combinations of alternatives and their associated impacts are described below. (Refer to the supplemental alternatives analysis contained in Appendix E.)

### 1. Upstream Storage with a Combination of Reservoir Sites

#### Description of Improvements

The SCVWD investigated six possible upstream storage sites in addition to the four sites discussed previously under the Upstream Storage alternative (refer to Appendix E). Of the six possible storage sites, only two were found to be feasible. One of these sites is the Hidden Villa Lower Pasture, located along Moody Road at the Hidden Villa entrance. The Hidden Villa Lower Pasture reservoir has a potential capacity of 70 acre feet. The other potentially feasible site is the Foothill Expressway site, located at Foothill Expressway and Adobe Creek. This Foothill Expressway site has a ten acre foot storage capacity. Therefore, the total capacity of both of these potentially feasible reservoirs would accommodate 80 acre feet (which represents only a minor portion of the 2,400 acre feet of storage capacity needed at Hidden Villa).

#### Description of Impacts

Construction of a reservoir at the Hidden Villa Lower Pasture site would require substantial excavation. Creation of this reservoir would result in noise and dust impacts as well as loss of wildlife habitat, including impacts to the rich riparian habitat of Adobe Creek where inlet and outlets to the reservoir are excavated. The present open space value and use of this site may be reduce by construction of the reservoir.

Construction of the Foothill Expressway reservoir would require excavation of approximately 1,300 truckloads of material. Construction impacts would include generation of noise and dust. Trucks entering and exiting the site would impact homes on Old Oak Court.

#### Conclusion

The construction of reservoir sites for this alternative would result in substantial excavation and wildlife habitat impacts. The impacts of this alternative would be substantially greater than for the proposed project.

2. Partial Channel Replacement with Trapezoidal and 17 Foot U-Frame

### Description of Improvements

The SCVWD analyzed partial channel replacement of 60 and 85 percent of the channel with floodwalls between Charleston Road and Alma Street. The SCVWD calculated that wall heights of 6.8 feet would be required for the 85 percent channel replacement and 6.5 feet for the 60 percent channel replacement.

### Description of Impacts

The floodwalls would have visual impacts to the backyards of the adjacent properties. This alternative would have generally similar construction impacts to those of the proposed project described previously.

### Conclusion

The impacts of this project would be very similar to those of the proposed project. However, this alternative would result in greater visual impacts than the project.

3. Diversion with Upstream Storage

### Description of Improvements

The Diversion with Upstream Storage alternative would consist of upstream storage at the Hidden Villa Lower Pasture site, and diversion of flows to Matadero Creek. This alternative would require construction of a channel or pipe across Alta Mesa Cemetery connecting to the Barron Creek Sediment Basin, and extending to the Matadero Creek Bypass. The capacity of the Barron Diversion, Matadero Creek Bypass, and Matadero Creek channel would have to be enlarged to accommodate the diverted flow. Six foot floodwalls would be required along Adobe Creek from Charleston Road to the SP railroad culvert, and the railroad culvert would need to be replaced.

### Description of Impacts

The Diversion with Upstream Storage alternative would result in construction impacts to the Hidden Villa Lower Pasture site, including loss of riparian habitat and potential loss of open space use by reservoir improvements. Construction of the reservoir would also result in construction noise and air quality impacts. Construction of the Matadero Creek Diversion would have impacts similar to those described previously under the Upstream Diversion alternative, but to a lesser degree. The impacts from installation of floodwalls and replacing the SP railroad culvert would be similar to those of the proposed project described previously.

### Conclusion

This alternative would result in similar construction impacts as the proposed project from Charleston Road to Alma Street. However, this alternative would result in significant impacts to riparian habitat and open space for construction of the reservoirs. This alternative would result in substantially greater impacts than the proposed project.

4. Reduced Diversion to Matadero Creek

### Description of Improvements

The Reduced Diversion to Matadero Creek alternative would be the same as the Upstream Diversion alternative, but with the diversion flow reduced by approximately two thirds (reduced from 1,915 cfs to 600 cfs). The floodwalls along Adobe Creek between Charleston Road and Alma Street would be approximately six feet high. The railroad culvert would also be replaced.

### Description of Impacts

Construction of this alternative would result in impacts similar to those described previously under the Diversion alternative. The principal differences are six foot floodwalls along Adobe Creek and installation of a diversion culvert that would be 8.5 feet by 8.5 feet in cross section instead of 13 feet by 12 feet.

### Conclusion

This alternative would result in substantially greater impacts than the proposed project due to the improvements required for upstream diversion. (See conclusion for Adobe Creek Diversion alternative.)

# SECTION IV

## ANY SIGNIFICANT ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED IF THE PROPOSED PROJECT IS IMPLEMENTED

The proposed project would result in three significant unavoidable impacts. These are as follows: 1) construction impacts, 2) potential archaeological/cultural impacts, and 3) visual impacts.

The project would result in the generation of high noise levels, dust, and general disruption of backyards and property adjacent to the creek channel during construction. The impacts also include potential damage to homes and structures from vibration or ground movement during or after construction, as described in this EIR. While the construction impacts are of limited duration at any given residence, they are considered significant and unavoidable.

Cultural materials are present at one location along the creek channel where they could be disturbed by construction. Impacts to archaeological resources can be mitigated by careful excavation, removal and recordation. Cultural materials sacred to Native Americans can also be reburied; however, in both of these cases the cultural resources would be substantially disturbed Therefore, the potential disturbance to cultural resources is considered a significant unavoidable impact.

Visual impacts would result from channel walls above ground level, and from the removal of mature trees and landscaping in the adjacent backyards as a result of channel construction. The replacement and regrowth of large trees and shrubs would take several years. For this reason, the visual impacts of the project are considered significant and unavoidable.

# SECTION V

## RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The project proposes to reuse an existing flood control right-of-way for reconstruction of a concrete lined channel to increase the capacity to accommodate the 100-year flood. The long-term effects of the project are to continue the use of an existing flood control right-of-way and channel for regional flood control protection. The specific impacts of the project have been identified in this EIR.

The cumulative impacts would result from the proposed project together with other downstream improvements and improvements to Barron Creek and Matadero Creek. The project would not have a significant impact upon biological resources or riparian habitat and would not have a significant cumulative impact. The significant construction and visual impacts of the project are limited to properties adjacent to the creek channel. These do not represent potential cumulative impacts since other projects would not affect these properties. The only potential cumulative impact of the project is upon cultural resources. This is a potentially significant cumulative impact since past development and construction activities have severely impacted cultural sites and future development could be expected to do the same. If the monitoring program proposed by the project determines that construction would actually impact cultural materials, proposed mitigation measures would reduce the impacts (as described previously in this EIR). Cumulative impacts to cultural resources can be reduced by the implementation of similar mitigation (or impact avoidance) for other construction and developments which may have impacts upon cultural resources.

The proposed project is being proposed at this time despite its impacts, in order to provide flood protection and avoid potential flood damages to property.

## SECTION VI

## ANY IRREVERSIBLE ENVIRONMENTAL CHANGES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

The only irreversible changes associated with the project are the use of non-renewable resources during the construction phase, including concrete and petroleum products.

## SECTION VII

## GROWTH-INDUCING IMPACTS OF THE PROPOSED ACTION

Flooding or inadequate flood control has not been and is not presently a constraint to development. Therefore, the project would not result in growth-inducing impacts. In addition, the project would not have a direct growth-inducing impact since it would not stimulate economic growth. The only exception is during construction, when construction related jobs are created and materials are purchased which may draw from local sources. The project does not propose a change in use or an expansion of services and, therefore, would not result in any secondary growth-inducing impacts.

## SECTION VIII

## EFFECTS FOUND NOT TO BE SIGNIFICANT

The potential environmental effects of the proposed project, both significant and not significant, are addressed in this EIR. The effects not found to be significant are generally as follows:

- Short-term bicycle and pedestrian traffic impacts resulting from temporary removal of the footbridge between Duncan Place and Creekside Drive.
- Privacy and security impacts resulting from the removal of existing backyard fencing and installation of temporary construction fencing.
- Privacy impacts associated with the proposed higher footbridge next to adjacent residences.

- Potential minor noise impacts and headlamp glare resulting from temporary relocation of the Southern Pacific railroad line closer to Alma Street.

- Relocation of utility lines for construction of the new creek channel.

- Slight increase in public safety hazard associated with the new U-frame (vertical wall) channel compared with the existing trapezoidal channel.

- The effects on vegetation and wildlife (habitat) resulting from removal of existing trees and other vegetation.

# SECTION IX

# EIR AUTHOR AND CONSULTANTS

## AUTHOR

**David J. Powers & Associates, Inc.**
Environmental Planners and Consultants
1885 The Alameda
San Jose, California

David J. Powers, Principal
Leianne Humble, Project Manager
Jodi Starbird, Graphic Artist

## CONSULTANTS

**CH2M Hill**
Geology
San Jose, California

**MO'C Physics Applied**
Noise and Air Quality
Palo Alto, California

# X. REFERENCES

Archeological Resource Management, Archeological Excavation at CA-SCI-600 on Adobe Creek, June 1988. On file with the SCVWD.

CH2M Hill, Geotechnical Assessment for Proposed Adobe Creek Improvements, August 1989.

City of Palo Alto, Palo Alto Comprehensive Plan 1980-1995, updated to 1989.

Harvey & Stanley Associates, Inc., Adobe Creek Biological Impact Assessment, March 1985.

MO'C Physics Applied, Adobe Creek Noise and Air Quality Assessments, September 1989.

Santa Clara Valley Water District, Jim Fiedler, David Hook, and Engineering Staff, personal communication, 1989.

Santa Clara Valley Water District, Adobe Creek Hydrology as Part of the Hydrology of Adobe, Matadero, and Barron Creeks, April, 1989.

Santa Clara Valley Water District, Adobe Creek Planning Study, Engineer's Report and Final Negative Declaration, June, 1985.

Santa Clara Valley Water District, Adobe Creek Phase IV Flood Control Alternative Analysis - Alma Street to El Camino Real, June, 1989.

Santa Clara Valley Water District, Matadero Creek Engineer's Report, 1988.

Santa Clara Valley Water District, Supplement to the Adobe Creek Phase IV Flood Control Alternative Analysis - Alma Street to El Camino Real, August, 1989.

# APPENDIX A

# DEFINITION OF ONE PERCENT FLOOD

Santa Clara Valley Water District
5750 ALMADEN EXPRESSWAY
SAN JOSE, CALIFORNIA 95118
TELEPHONE (408) 265-2600
AN AFFIRMATIVE ACTION EMPLOYER

# THE ONE PERCENT FLOOD

## Definition

The one percent flood is that flow of water from a drainage area that, on the average and over a long period of time, has a one percent chance (probability of 0.01) of being equaled or exceeded in any given year. It is sometimes referred to as the 100-year flood, but it should not be thought of as an event that occurs regularly every 100th year. Instead, it is the flood flow that would be equaled or exceeded perhaps about 100 times in 10,000 years. It is also possible that two repetitions of this flood flow could occur in a single year, or that a single event may not occur even once in 200 years.

## The 1% Flood and the 1% Storm

Another terminology problem is the relation of the one percent storm and the one percent flood. Storm magnitude relates to flood magnitude through a complex set of parameters such as antecedent rainfall conditions, drainage basin shape, length, slope, orientation, and other factors. Therefore, a one percent storm will not necessarily produce a one percent flood. The one percent flood should not be confused with nor should it be referred to as the "one percent storm" or the "one percent storm flood."

## Cumulative Risk

The one percent flood has a small risk of occurrence in a given year, but the risk is cumulative. When compared with the 30-year life of the average home loan, for example, the chance that such a flood will occur is quite large. During the 30-year loan period, the chance that a one percent flood will occur, or will be exceeded, approaches 30 percent.

## The "1% Flood" and the "Design Flood"

Another relationship that requires explanation is that which exists between the "one percent flood" and a "design flood." A design flood is any particular flood magnitude chosen for designing a flood control project. A design flood could be the one percent flood or it could also be a flood of another frequency of occurrence. The one percent design flood (used by the District as its design standard) represents the expected future flow of water from a watershed without constriction, undue storage or delay. The one percent flood under existing watershed conditions (the existing one percent flood) is the flood developed from a watershed with existing limited capacity channels. Such a flood is used by the Federal Emergency Management Agency as a standard for its flood insurance program.

## 1% Peak Flows and 1% Volumes

In general, floods are identified in terms of their peak flows and volumes. In practice, the one percent flood refers to the one percent peak flow rate when designing flood control channels and similar water structures. The 1% flood also refers to the one percent volume of water when defining overbank storage or when designing flood retention and detention facilities.

## The District's Hydrology and the 1% Flood

The magnitude of the one percent flood is calculated using statistical hydrologic methods. The District uses a uniform method of determining the one percent flood; one that is regional in scope and based on the best available rainfall and runoff information from areas within and adjacent to the County. The regional process utilized by the District was developed after considerable effort and has been reviewed and approved by the academic and professional communities.

## Factors Affecting Floods

The major causes of floods are the preceding storms and their intensity distributions. Other factors that could affect the peaks and/or volumes of floods relate to the physical characteristics of watersheds, either rural or urban.

For rural watersheds these factors are: slope, groundcover, basin shape, soil type, etc. For urban watersheds, natural conditions are modified by increasing the impervious areas and by making the flow paths more efficient. Roof tops, pavement, rain gutters, downspouts, curbs, storm drains, levees and culverts can increase the volumes and peaks of flood flows, especially in hilly terrain with steep slopes.

In the flat land, the limited capacity of the storm drainage system and the conditions of the levees along the adjacent channels may reduce the peaks of larger urban floods and thereby retain the water in the urban watershed for a longer time. This may serve to increase local flooding of urban areas and cause no increase in the flow within the main channel. Therefore, depending on the local conditions, urbanization could have the effect of increasing or decreasing the flow in the main channels.

A. D. Saah
March 21, 1989

# APPENDIX B

# HYDROLOGY REPORT

Prepared by Santa Clara Valley Water District

SANTA CLARA VALLEY WATER DISTRICT

# ADOBE CREEK HYDROLOGY
# AS A PART OF
# THE HYDROLOGY OF ADOBE, MATADERO AND BARRON CREEKS

prepared by

A. D. Saah, P.E., P.H.
Civil Engineer (Hydrologist)

under the direction of

Stan N. Wolfe, P.E.
Head, Project Development Branch

John T. O'Halloran
General Manager

Robert R. Smith
Flood Control Manager

April 27, 1989

# TABLE OF CONTENTS

Page

PREFACE....4
PURPOSE OF THIS REPORT....5
GENERAL QUESTIONS AND ANSWERS.... 6

BACKGROUND....10

- Hydrology ....10
- The Importance of Good Data .... 11
- Inherent Errors.... 11
- Gaged Watersheds....12
- Ungaged Watersheds....13
- Synthetic Data....13
- Hydrologic Methods ....14
- Empirical Method ("Rational Formula")....15
- Statistical (Stochastic) Method....15
- Deterministic Method....16

THE DISTRICT'S HYDROLOGIC METHOD....18

- Three Cross-Checking Techniques....19
- Compounding Probabilities....20
- The District's Analyses....22
- Rainfall/Runoff Analysis....23
- Statistical Analysis of the Matadero Creek Stream...23
- Regional Flood Frequency Analysis....28
- Final Design Flood Flows....30

USE OF HYDROLOGIC PROCEDURES....35

CONCLUSIONS....38

APPENDICES:

I. Diagram of Districts Hydrologic Method....39
II. Analysis of Updated Records at Matadero Gage....40

BIBLIOGRAPHY....45

## FIGURES

1. Matadero Creek Stream Gage (Peak Flows)..........25
2. Matadero Creek Stream Gage (Daily vs. 24-Hr. Volume)...................... 26
3. Matadero Creek Stream Gage (Design Volumes)......27
4. Map of Pacific Slope - Region A.................29

## TABLES

1. Summary of District Flow Values................. 32
2. 1% Design Flood Flows............................33
3. 10% Design Flood Flows...........................34
4. Use of Hydrologic Procedures.....................36
5. Hydrologic Methods Used by Flood Control Agencies in California...........................37

# PREFACE

In answering the questions about the hydrology of Adobe Creek, this report addresses the hydrologic analyses done in 1978 on Matadero, Adobe and Barron Creeks. It also discusses the stability of the findings of the 1978 study when compared with a statistical analysis of the data from Matadero Creek Gaging Station through the 1989 water year.

Home owners adjacent to the flood control project on Adobe Creek between Alma Street and Charleston Road have asked for a description of the District's hydrologic methods and analyses used to determine the extent of needed channel improvements. This report explains the District's hydrologic methods and provides a discussion of methods used by others. The report does not discuss the channel capacity and related hydraulic analyses.

## PURPOSE OF THIS REPORT

The report has been prepared in response to requests by the public. The purposes of the report are to:

- Describe the District's hydrologic methods.
- Explain how the District's hydrologic methods were applied to the Adobe Creek flood control project.
- Provide an over-view of other methods to show how they compare with the District's.

# GENERAL QUESTIONS AND ANSWERS

Following are some questions that have been commonly asked by the members of the public, together with answers that will clarify these complex hydrologic issues.

## What is the issue?

The Santa Clara Valley Water District has determined that the existing Adobe Creek channel is inadequate to contain the 1% flood and therefore has planned a flood control project to mitigate that problem.

Some of the residents along Adobe Creek have expressed concerns about the channel improvements required, and have asked for a description and explanation of the District's hydrologic study (that is, the District's estimation of the amount of flood water to be accommodated by the Adobe Creek channel).

## What is hydrology?

Hydrology is the science that deals with the circulation of water. Flood control hydrology is the science of estimating the magnitude of floods from watersheds and analyzing their frequency of occurrence. Flood waves (hydrographs) are described as having peaks and volumes. Flood control agencies throughout the nation use the 1% peak flow (flood) to design flood control channels, and the 1% flood volume to design flood basins, etc.

The 1% flood is that flood having a 1% chance of being equalled or exceeded in any year. The 1% flood has been adopted by the Federal Emergency Management Agency (FEMA), the United States Soil Conservation Service (SCS), the Corps of Engineers (COE) and most local flood control agencies as a design standard for flood protection measures.

### Does the District's hydrologic method rely only on simple text book formulas and tables?

No. The District's hydrologic analyses of Adobe Creek and others includes complex hydrologic and statistical computer models. The intensive use of the District's hydrologic data base, together with these computer models, permitted the analysis and re-analysis of great amounts of data for many different design conditions. These are available for the public's inspection at any time.

### Is hydrology an exact science?

No. It has many practical applications, such as flood control, which deal with natural processes that are random and ever-changing. Therefore, it's dependent on the laws of probability for the analysis of past data and the projection of future expected events and their chances of occurrence.

### Some might say that the District's hydrology compounds the probabilities and results in high values. Is this true?

No. Although there is no hydrologic method that is immune to the possibility of compounding probabilities, all responsible hydrologists acknowledge that possibility and are careful to avoid producing results which have, in fact, a greater or lesser chance of occurring than 1% each year. The District has demonstrated that any such compounding in it's method is negligible.

### Are there ways to verify the results of the study on Adobe Creek?

Yes. The data on the Matadero Creek USGS gaging station, together with 28 other gaging stations, were used in 1978 to develop the regional hydrology methods that are used at the present time. In addition, the Matadero Creek gaging station is also used to verify the site-specific application of the regional methods on both Matadero Creek and Adobe Creek. The use of Matadero Creek data to infer information about the Adobe Creek design flows is an accepted procedure that is used throughout the profession. Those data represent the best available information in the area. In other words, the Matadero Creek gaging station was used as a guide and a measure of the applicability of the model to the Adobe Creek watershed in addition to the Matadero creek watershed.

To verify the design flows on Adobe Creek, an analysis of the data from Matadero Creek station, covering the period through 1989 was done. The results show that the design flows obtained in 1978 are still valid today, and the possibility of changing them due to new data (between 1978 and 1989) is very small (see Appendix II).

## Do the District's hydrology methods conform to accepted standards in the field of professional engineering and flood control design?

Yes. As described in this report, the District -- along with several other flood control agencies -- has evaluated most of the models used in this field, and has chosen to use the methods used by all of the local, state and federal agencies. The District's hydrologic methods are considered to be state-of-the-art.

## What is the effect of urbanizing the upper watershed on Adobe Creek?

The effect of urbanizing the watershed is a subject that is addressed in our hydrology study. Increased imperviousness and channelization are two major changes that take place as the result of urban growth. If rainfall is the inflow to an urban area, then the discharge through the gutters, storm drains and streets is the corresponding outflow. On the valley floor, where the land is relatively flat and stormdrains are designed for very frequent (small) floods (2 to 10 year floods), urbanization tends to retain the local design (large) floods in the urban area for a longer time thereby reducing the flows in the main flood control channels. In the foothills the effect of storm drains as a constriction is not seen. Urban growth in the upper watershed increases the flow in the main channel, especially if the land use density is high and the cumulative effects are accounted for.

The extent of urbanization of the Adobe Creek upper and lower watersheds was assumed, for the purpose of this study, to conform to the General Plans of the cities. Deviating from the General Plans could cause induced flooding. Those problem are site-specific, that should be addressed in the EIR processes associated with such deviations.

## Is hydrology based on statistics and not real measurements?

Flood control hydrology is based on the statistical analysis of recorded natural processes (real measurements). Long term streamflow and precipitation data are some of the natural processes that are usually used in the analysis. The data are quantitative measurements of the behavior and the response of the designated watersheds.

## It is understood that the error in defining the design value is 10% to 20%. With a margin of error like that how can one develop a confidence in the proposed project?

The flood control design values are, by definition, probabilistic events (1%, 10% flows etc.). Therefore, one has to depend on recorded data to define that event and its frequency of occurrence.

The error that is associated with that event is what statisticians call the "standard error of estimate". It is directly proportional to the variance of the data and inversely proportional to the number of years of record. In this area the number of years of record is usually less than fifty--a small sample when compared to the population of years spanning the life of any creek. Because of the size of such samples it is impossible to get an absolute value for the correct design flows. What one gets is an estimate of the design flow value with an associated standard error. The objective of a good study is to reduce the standard error of estimate. Using stochastic hydrology, the District has accomplished this objective by extending the recorded data to include information from adjacent stations.

# BACKGROUND

To better understand the reliability of the District's hydrologic method, some background information is offered.

## Hydrology

Hydrology is concerned with the study of the natural water cycle that begins with evaporation of water from the oceans and other bodies of water and continues with the formation of clouds, precipitation (rainfall) and then the complex distribution of that rainfall through evaporation, transpiration through plants and their leaves, infiltration into the ground, runoff into streams and major creeks and channels to the oceans where the description of the cycle began. Actually, the hydrologic cycle is much more complicated than this simplified characterization and is the target of a great deal of research and debate. An understanding of the hydrologic cycle must include consideration of the timing of various hydrologic events (lag time between precipitation stations, lag time between storm intensities and their corresponding runoff, etc.).

Flood control hydrology deals with one part of the larger hydrologic cycle - the estimation of flood flows and, more specifically, the estimation of the frequency with which a peak flow and volume of runoff of a given magnitude can be expected to be equalled or exceeded in any year. The aim of flood control hydrology is to improve the statistics (mean, variance, skewness, etc.) of floods that could be generated from a given watershed. For example, to design a flood control channel, engineers need to know the peak flow; that is, the maximum rate of runoff in cubic feet per second (abbreviated cfs) that could, on the average, be expected to be equalled or exceeded once in 100 years (said to have a 1% chance of being equalled or exceeded in any one year). Likewise, maximum volumes of rainfall runoff (expressed in acre-feet, abbreviated ac-ft; or in cfs-24 hours) and frequency of occurrence are desired for the design of other flood control facility, such as reservoirs, sediment basins and flood retention facilities.

Although peak flow and volume of runoff can be analyzed for any frequency of occurrence (say two-year, five-year, ten-year, twenty-year, etc., or 50%, 20%, 10% and 5% probabilities), the nationwide standard for flood control design was chosen -- based on economics -- to be the 100-year, or 1% flood.

A limited number of hydrologists assert that peak flows and maximum volumes are not related -- that these events are independent from each other. For floods in California, there is no question that peak flows are related to maximum volumes (cross correlation coefficient more than 0.90). Usually floods occur as a result of intense storms (storms that are usually cyclonic with large fronts). Therefore, we define the 1% flood to be that flood event having a 1% peak and a 1% volume. The question of compounding of probabilities is discussed later.

## The Importance of Good Data

All hydrologic methods rely upon historical data. Streamflow records and rainfall records are essential to any analysis of floods and their frequency of occurrence. Depending on many factors, historical streamflow data at a certain location represent the actual response of the watershed to rainfall activity. Since our interest is in flooding, records of maximum annual streamflows are of more importance to the District than rainfall data.

---

"It is recommended that rainfall data be given a secondary role... in Santa Clara County. Runoff data for about 40 stream gaging stations in the county and around it will produce much more reliable information on floods than the synthesis of precipitation data could yield". (Yevjevich and Simon, 1967, see Bibliography Ref. #1)

---

## Inherent Errors

All historical records have inherent errors that must be dealt with during hydrologic studies:

- Normal Errors are those that exist because of the variability of natural events. All hydrologic methods are subject to these errors.

- Sampling Errors exist because of the deficiencies that result from trying to represent a large amount of data with only a limited sample. All hydrologic methods deal with this type of error.

- Man-made Errors come about because of the inadequacies of certain techniques in handling historical data or in creating data. One such technique which can bias its results is to "simulate" streamflow data by attempting to model the relationship between rainfall and runoff. Such synthetic data are particularly subject to biases that can render the results useless, especially in the case of extreme (flood causing) events.

In relying upon historical records of streamflow and precipitation, great care is taken to ensure the quality of those historical data. While there may be many private, unpublished records kept by individuals, these cannot be used without further assurances that the data were collected in a manner consistent with standards of scientific data collection. Data published by responsible data collection agencies are usually collected by qualified individuals and, by publication, are subject to further scrutiny by the professional community. It is safer for hydrologists to use such data rather than data obtained from private collectors. The State of California Department of Water Resources (DWR) and the United States Geological Survey (USGS) publish precipitation and streamflow records. The Santa Clara Valley Water District is a contributing agency in these data collection publishing programs.

## Gaged Watersheds

Many streams in Santa Clara County have recording stream gages at various locations. Also, a network of over 100 precipitation stations in Santa Clara County automatically record rainfall and provide a long, historical record. Many other streamflow and precipitation stations outside of Santa Clara County - but within the immediate hydrometeorologic (weather) area - complement the District's in-county data network.

## Ungaged Watersheds

Many streams and watersheds do not have historical streamflow records. In order to have hydrological data that can be used for flood control design in these ungaged watersheds, some method must be used to estimate peak flows and volumes without benefit of data specific to the watershed. This problem must be addressed regardless of which of the several hydrologic methods is used (a discussion of the various hydrologic methods follows). Nor do all streams and watersheds with precipitation gages and/or stream gages have records that are entirely continuous over the life of the gage. Various circumstances occur during the life of hydrologic gaging devices that can interrupt the data collection process. Such periods can last for hours, days, weeks or even months.

## Synthetic Data

To enhance historical streamflow records, that is, to develop synthetic data, hydrologists use some form of mathematical modeling. The District uses such mathematical (stochastic) techniques for "filling in" missing data, or for extending short records of data on gaged streams using longer historical streamflow records of adjoining streams and watersheds. This "filling in" process permits longer and more continuous records to be made available without sacrificing the statistical quality of the data. Such stochastic data are what statisticians consider "random, continuous and homogeneous and with a known standard error of estimate" - qualities that permit further rigorous statistical analyses.

Some hydrologists use computer techniques to "simulate" missing streamflow data using rainfall data. Rather than using information from adjoining streamflow stations, the process of "simulating" data attempts to model the continuous and, hence, extremely complex relationship between rainfall and runoff. In such models, many human judgement factors enter into the process. For example, some natural processes, such as the area-wide distribution of rainfall, are quite variable over a period of time. Nonetheless, simulation models such as the Stanford Watershed Model are most sensitive to rainfall. The results of such modeling can therefore be biased because of the many assumptions that are needed, such as the assumption of constant rainfall distribution.

## Hydrologic Methods

As there is more than one opinion on the "best" way to handle the problems of incomplete historical records and ungaged watersheds, there is also more than one opinion on the "best" hydrologic method to estimate runoff peaks and volumes. In fact, some methods are adequate for some engineering applications but not for others.

If there is a consensus at all, it is that for gaged watersheds - that is, for watersheds that have long records of streamflow - there is no better method for deriving design peak flows and design volumes than by the statistical analysis of the historical record - checked if possible against the statistical data from any nearby watershed - and further checked against statistical data for the general region applied to the particular watershed. This is standard practice for the Santa Clara Valley Water District and, with some variation, for the majority of flood control agencies.

However, since most watersheds are not adequately gaged, or are not gaged at all, different points of view among hydrologists arise with regard to analysis of ungaged watersheds.

At the turn of the century, hydrologists began using simple statistical and mathematical tools (such as the rational formula described below, and straight-line projections). As more recorded data become available, scientists and mathematicians became more involved in seeking the best use of the data and quickly many new techniques evolved (various frequency distributions, different interpretations of rainfall and runoff relationships and the movement of resultant flood waves over land). As a result, hydrologists across the nation started using these techniques, each based on his own background. This generated inconsistent results, and controversies started. In the late 1960's and early 1970's, the federal government recognized the problem of inconsistent interpretation of hydrologic events and decided to adopt a standard hydrologic method. This was needed for the administration of the National Flood Insurance Program which was in the final stages of nationwide adoption.

The result of the federal efforts in arriving at a national consensus on hydrologic method was the publication of a unifying document - Bulletin #17, Guidelines for Determining Flood Flow Frequency - by the President's Water Resources Council (WRC). Most hydrologists accepted the document and its recommendations.

In the 1970's, the National Flood Insurance Program was fully implemented. The WRC Bulletin #17 in combination with the Corps of Engineers unit hydrograph technique (described later in this report) were found to have a unifying effect and were, therefore, used by the Flood Insurance Administration for its flood mapping program.

As the National Flood Insurance Program applied the above-described techniques, most flood control agencies adopted these same hydrologic methods for estimating peak flows and runoff volumes. The Santa Clara Valley Water District was the foremost user of those techniques and improved upon them by use of stochastic methods for augmenting the relatively short historical stream gage record at some of the District's stations.

There are several approaches to hydrology in use today by flood control and storm drainage agencies and design firms:

### Empirical Method ("Rational Formula")

This is a method for estimating peak runoff and is only suitable for watersheds of extremely small size (perhaps several acres) of uniform surface, such as paved parking lots or city streets. It is no longer applied realistically to large, complex watersheds that have rural as well as urban characteristics.

### Statistical (Stochastic) Method

This method involves the statistical analysis of historical streamflow and rainfall data (runoff peaks and volumes). As with other methods, the desired results are reliable estimates of 1% (100-year) peak flows and the associated volume of runoff. The backbone of this hydrologic method is the comprehensive mathematical (stochastic) analysis of historic streamflow data. It includes nationally recommended techniques to expand on the historical record and to fill in missing data by using mathematical modeling. Based on the resultant historic and stochastic data, final estimates of design peak flows and volumes can be analyzed by standard statistical procedures. The standard error of estimate (or equivalent number of years) of the design flows can be determined and used to define the goodness of the estimated values.

### Deterministic Methods (Continuous Modeling)

Deterministic hydrologic methods attempt to model the continuous and complex relationship between rainfall and runoff. One such deterministic program is the Stanford Watershed Model (SWM) developed in the early 1960's. Continuous modeling is proving useful for analyses of pollutant discharge volumes and, to a limited extent, for flood warning systems. However, to date, it appears that SWM does not lend itself to flood control design for reasons that will be explained.

The idea of continuous modeling is to describe the continuous long term rainfall-runoff relationship using mathematical formulas and functions that try to account for all rainfall once it lands on the surface of the watershed until it passes through the maze of complex paths that water can take after that time. Through an accounting procedure, estimates are made of the runoff that makes its way to the major flood carrying watercourses. The computer model is "calibrated" against a small part of the available historical data for the watershed. If the watershed has no data, then the model is calibrated against the nearest available historical data from some adjoining watershed. The calibrated model is used to generate "simulated" runoff data for periods longer than the period of calibration.

The District's method, described below, results in the description of a single flood wave with a specific peak flow, volume, shape and frequency of occurrence. Continuous simulation, however, results in the generation of a continuous time-series of peaks, volumes, etc. Statistical analyses of such continuous series would generate design values (peaks, volumes, water surface elevations, etc.), but without a common denominator that relates these design values to each other. In simulation, it is claimed that design flood volumes do not coincide/correlate with design flood peaks, and that the total design flood does not have the same probability as that of peaks and volumes regardless of the magnitude and intensity of the storm. Such claims are not supported by the data analyzed by the District, where cross correlation of peaks and volume are higher than .90, a good indication of direct dependency.

Continuous models are made to manage large quantities of input rainfall data to "perform deterministic simulation of a variety of aquatic processes" (R. K. Linsley). As a result, deterministic data -- or data that could be reproduced given the same input values -- are obtained and are treated as purely random events. It is not clear how much randomness is left in this type of data. Also, it is not clear whether the contemporary laws of statistics apply to such results and, if they do, under what conditions and limitations.

# THE DISTRICT'S HYDROLOGIC METHOD

The District's hydrologic method has evolved over many years into a procedure that has achieved the endorsement of nationally and internationally respected hydrologists. It is a statistical method similar to that in use by the majority of flood control agencies nationwide. A panel of nationally recognized hydrologists reviewed the District's method in 1976 and recommended that it be disseminated to other flood control agencies for possible adoption as a national standard.*

The method relies primarily upon historical local as well as regional streamflow data and secondarily upon rainfall data. Santa Clara County is fortunate in having many years of streamflow and rainfall data collected at over one hundred gages under a highly competent data collection program. In addition to the District-maintained hydrologic gage network, there are several gaging stations owned and operated by the United States Geological Survey (USGS), and others.

---

"The secondary role of precipitation means only that the rainfall data, with its more accurate properties (say annual or seasonal values) should be used" for estimation of parameters of flood frequency distributions on ungaged watersheds (Yevjevich and Simon, 1967)

---

With the above as background, the following is a general description of the District's hydrologic method. A more technical description of the method is available from the District upon request.

---

*The panel, and their affiliations in 1976, were: Professor Leo R. Beard, University of Texas; David R. Dowdy, U. S. Geological Survey; Professor Neil S. Grigg, Colorado State University; Professor L. Douglas James, Georgia Institute of Technology; Professor V. Yevjevich, Colorado State University.

## Three Cross-Checking Techniques

The District uses a statistical method as described in the previous section on general methods. Rather than relying on a single statistical analysis, the District utilizes three independent techniques that derive comparative results (design peak flows and maximum volumes). Those three independent techniques are:

1. An analysis of the rainfall/runoff relationship for the watershed (unit hydrograph analysis). Sample results from this analysis are:
    1% peak flow (1)
    1% runoff volume (1)

2. A statistical analysis of historical stream gage records in the watershed of the facility being designed. Sample results from this analysis are:
    1% peak flow (2)
    1% runoff volume (2)

3. A regressive analysis of historical streamgage records of streams in the surrounding area (regional flood frequency analysis) as applied to the watershed in question. Sample results from this analysis are:
    1% peak flows (3)
    1% runoff volume (3)

The results of the three independent analyses are compared. In fact, the three sets of results can each be given a numerical weighting factor equal to the calculated standard error of estimate, and the finally selected 1% peak flow and 1% volume can, if appropriate, be computed as the weighted average of each of the three results. In some cases the use of a weighted average is not recommended, and rather, one of the three sets of results might be selected for design.

It should be noted that the District's hydrologic method could accommodate a fourth, fifth, sixth, etc. technique in addition to the present three if the additional techniques were to be statistical in nature - that is, if they were each to have a computable standard error of estimate as normally considered by statisticians. To date, there are no other such techniques beyond those used by the District.

The District's three techniques are shown in a block diagram presented in Appendix I.

## Compounding Probabilities

As previously explained, flood control agencies usually design and construct flood control measures to contain the 1% (100-year) flood. Floods can be grouped according to any frequency of occurrence - annual floods, 10-year floods, 20-year floods, 50-year, 100-year, 200-year, 300-year, 1000-year, etc. The 100-year, 1% flood is the common standard that has been accepted for design of flood control facilities. Hydrologists, when they produce estimates of floods, are careful that their results actually do have a 1% chance of happening in any year; otherwise the accepted 1% standard may not be achieved. Probabilities of the individual components of floods must be considered so that the end product has a probability of 1%.

Since all hydrologic methods deal with the statistics of flood events, there is always the possibility of inadvertent compounding of probabilities. This is a subject that hydrologists seem to like to bring up when confronted with differences of opinion - especially when the disagreeing parties subscribe to different hydrologic schools (the "stochastic school" versus the "deterministic school", for example). If a hydrologist considers that the probability of occurrence of each of two assumably unrelated factors -- such as peak flows and volumes -- is one in one hundred (a .01, or 1% chance of each of them occurring), then actually he may have recommended a design flood that has a probability of occurrence of one in ten thousand (.01 multiplied by .01), rather than one in one hundred.

However, if two events are dependent - that is, two phenomena of nature whose individual behaviors are directly related to each other - then, there is no compounding of probabilities, especially when statistical analysis shows the cross correlation between the two events to be very high.

The criterion in these cases is that if the correlation coefficient between peaks and volumes is less than 0.9, then it may be said that their coincidence is less probable and some compounding of probabilities is likely. For Matadero Creek, the computed correlation coefficient between peaks and volumes is 0.942 for the recorded data alone and 0.964 for recorded data combined with derived (reconstituted) data. Therefore, there is no question that peaks and volumes are highly correlated and that the compounding of probabilities in the resultant flood is not significant. The combination of the probability of peaks and volumes can safely be assumed to be equal to the probability of the resultant flood. This is because floods are caused by extreme storm events with periods of intense rainfall. Such storms are frequent in this geographical area. Intense storms with small volumes of runoff are usually characteristic of arid (desert) areas and not Santa Clara County.

--------------------

"Because the individual peaks and volumes are highly correlated, the effect of considering joint probability may change the resultant probability very little". (1976 Panel Report,page 35, Bibliography Reference #2.)

--------------------

Because the District's computed cross correlations are in fact less than 1, it is understood that some extremely small amount of compounding of probabilities could occur. For that matter, no hydrologic method used today is immune to the possibility of compounding of probabilities. This is especially the case with methods that attempt to transform rainfall records to runoff records at various locations by assuming that the coincidence of timing of rainfall and all other parameters is extremely probable.

In fact, the very small amount of compounding of probability in the Districts method is further reduced by using peak flows to design flood control channels, and flood volumes to design storage facilities, but never peaks and volumes together.

Because of the reasons described above -- that is, the high correlation between peak flow and maximum volume and the fact that there is no need to combine peak flows and maximum volumes to design water structures -- the possibility of compounding probabilities in the District's method is negligible.

## The District's Analyses

The District has calculated 1%, or 100-year, peak flows and their related runoff volumes for the watersheds of Adobe Creek, Matadero Creek and Barron Creek. The results of that study are documented in the District's 1978 report Hydrology Documentation for the Northwest Flood Control Zone. That report, and several others available at the District office, provide more detailed information.

The first part of the District method employs the unit hydrograph technique (as presented in the Corps Of Engineers HEC-1 program) to convert a design storm to a corresponding flood. Based on that a generalized hydrologic model is built that simulates the response of each of the three watersheds (Adobe, Matadero and Barron) to design storms. The inputs to such a model are:

- The synthetic unit hydrograph parameters that were generated for each sub-watershed of the three creeks.
- The storm volume, its duration and the frequency of occurrence as developed from the analysis of the long term rainfall data in and around the watershed.
- The areas of watersheds or sub-watersheds, slope, antecedent flood conditions and the recession characteristics as well as the loss rate functions.

The output hydrographs from such a rainfall/runoff model have peaks and volume that represent the application of the deterministic (single storm) part of the District's hydrology method.

Of the three creeks, only Matadero Creek is instrumented with a gaging station that has a long historical record of streamflows and volumes. The newly constructed gage at Adobe Creek (constructed in 1987) is not mature and is of no value for statistical analysis at the present time. For this reason the record from Matadero gaging station was used to verify the results of the hydrologic rainfall-runoff model discussed above. Such verification (calibration) of the model on the gaged Matadero location will permit the use of this model on the Adobe Creek watershed (an ungaged watershed).

At the Matadero Creek gaged location near El Camino Real, design peak flows and corresponding volumes were calculated using the three separate techniques described previously. The results of those analyses are described as follows:

## 1. Rainfall/Runoff Analysis

The first independent analysis by the District dealing with rainfall-runoff transformation, as discussed above, was used to generate independent estimates of peak flows and volumes on Matadero Creek at the gage location near El Camino Real.

The results of the unit hydrograph analysis for the 1% flood on Matadero Creek are shown on Figures 1 and 3 as points on the frequency lines. The 1% peak and volume so determined are:

| | |
|---|---|
| Peak Flow: | 2091 cfs |
| Volume: | 24-hour volume = 909 cfs-24 hours (which is equivalent to 1,800 acre-feet or about 4.5 inches of excess rainfall). |

## 2. Statistical Analysis of the Matadero Creek Stream Gage Records

Analyses of the streamflow data at the Matadero Creek gage are shown on the following graphs. Figures 1 and 2 show how the actual historical and derived (stochastically reconstituted) peak flows and historical and reconstructed volumes (dotted points) rank with respect to frequency of occurrence. The solid lines through the data points in the two graphs have been plotted using the recommended technique of the United States Water Resources Council, 1976. In Figure 1, the broken heavy line shows the design condition and reflects the effects of urbanization which can, because of the proliferation of paving, roof tops and other impervious surfaces, act to increase runoff. That effect is more pronounced for frequent flood events (left end of the graph) and less pronounced for less frequent flood events (right end of the graph).

Figure 2 shows the dramatic differences that can result if the maximum 24-hour volumes (appropriate for design) are plotted against the maximum daily (calendar day) volumes (inappropriate for design). The District analyses utilize 24-hour volumes.

Figure 3 shows the design 24-hour volume (heavy broken line) compared to the historical record. Notice the effect that urbanization has on increasing runoff volumes as shown by the line labeled "urbanization'.

The District's analysis of the Matadero Creek stream gage records gives the following estimate of the 1% peak flow and corresponding volume (Figures 1 and 2):

Peak Flow: 2310 cfs (the District's 1978 Northwest Zone report inadvertently reports this as 2170 cfs due to a typographical error).

Volume : Daily volume (calendar day) = 560 cfs-days (which equates to 1,108 acre-feet of volume or about 2.8 inches of excess rainfall).
24-hour volume = 710 cfs-24 hours (which equates to 1,405 acre-feet of volume or about 3.7 inches of excess rainfall).

# MATADERO CREEK STREAM GAGE
## Near El Camino Real
## PEAK FLOWS

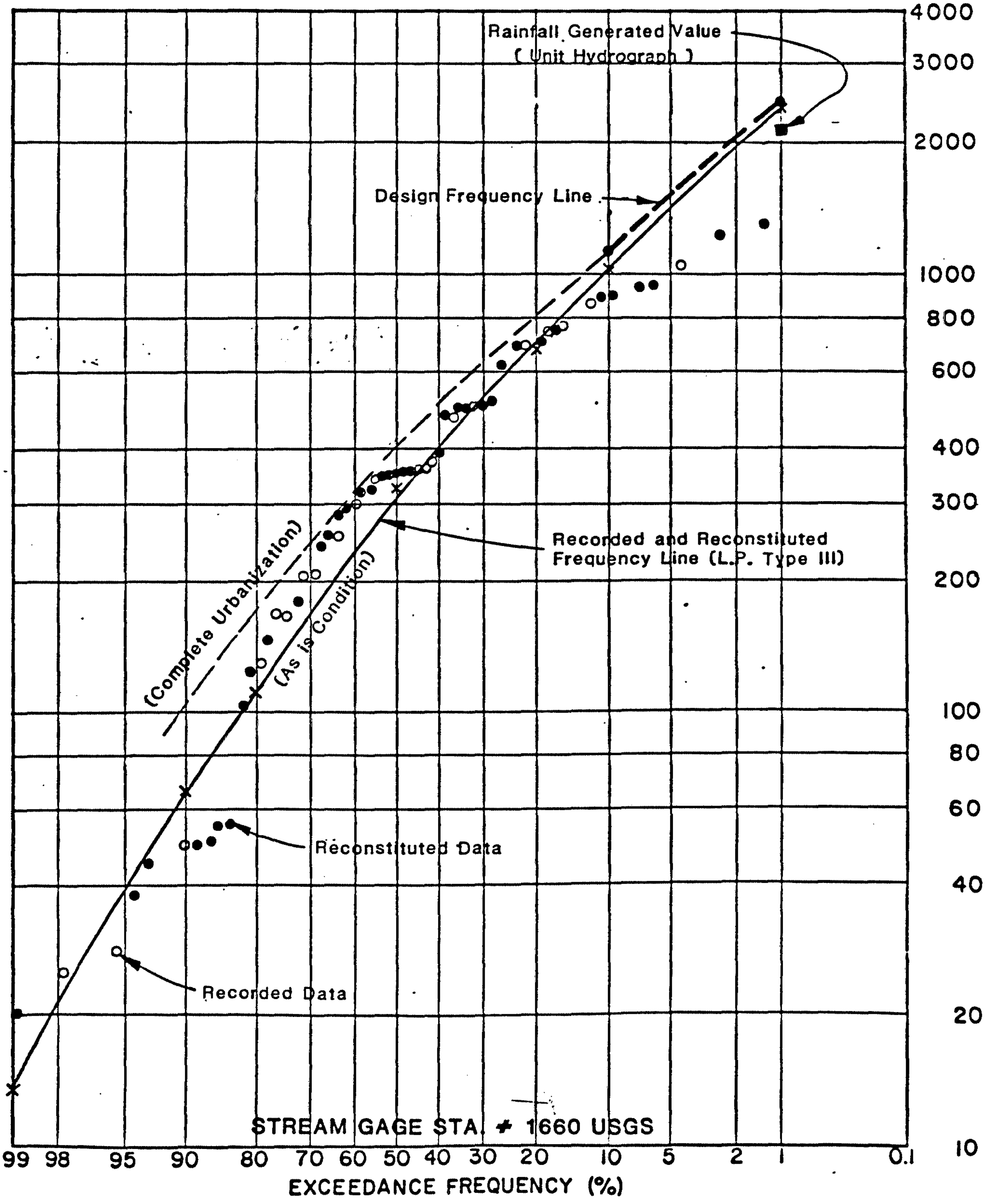


FIGURE 1

# MATADERO CREEK STREAM GAGE
## Near El Camino Real

( Comparison Of Daily Vs. 24-Hr Volume )

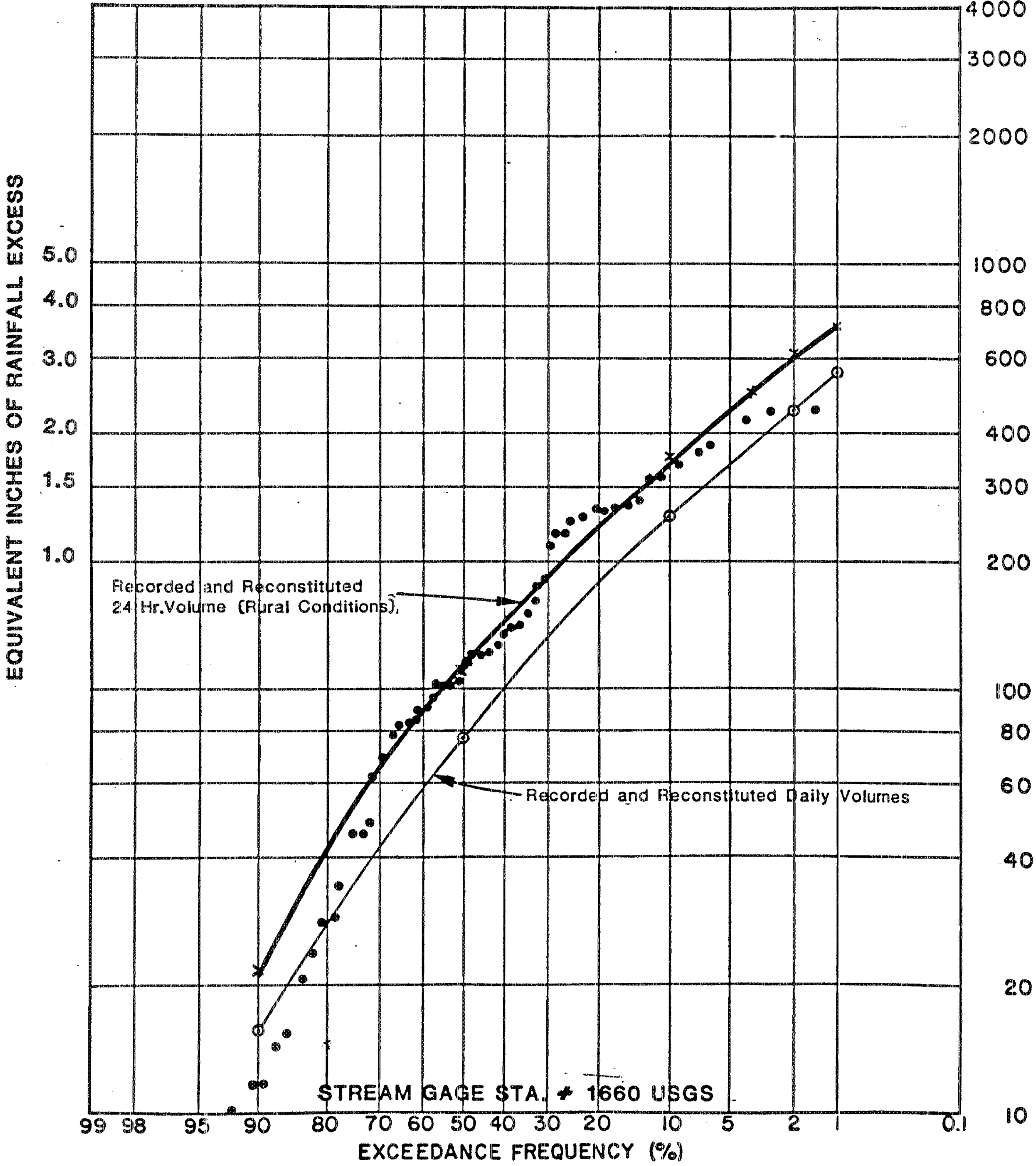


FIGURE 2

# MATADERO CREEK STREAM GAGE

## Near El Camino Real

( Design Volumes )

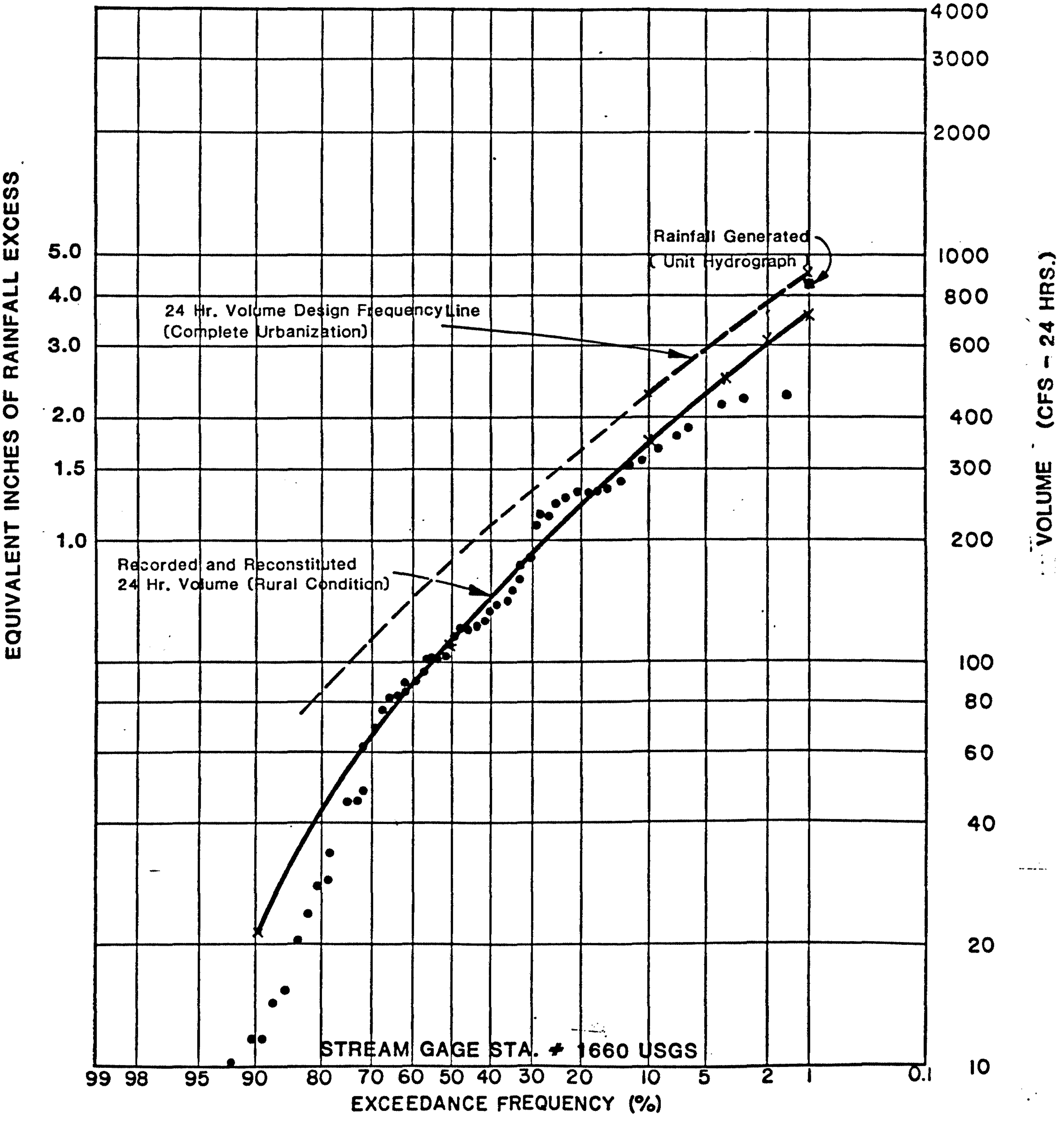


FIGURE 3

### 3. Regional Flood Frequency Analysis

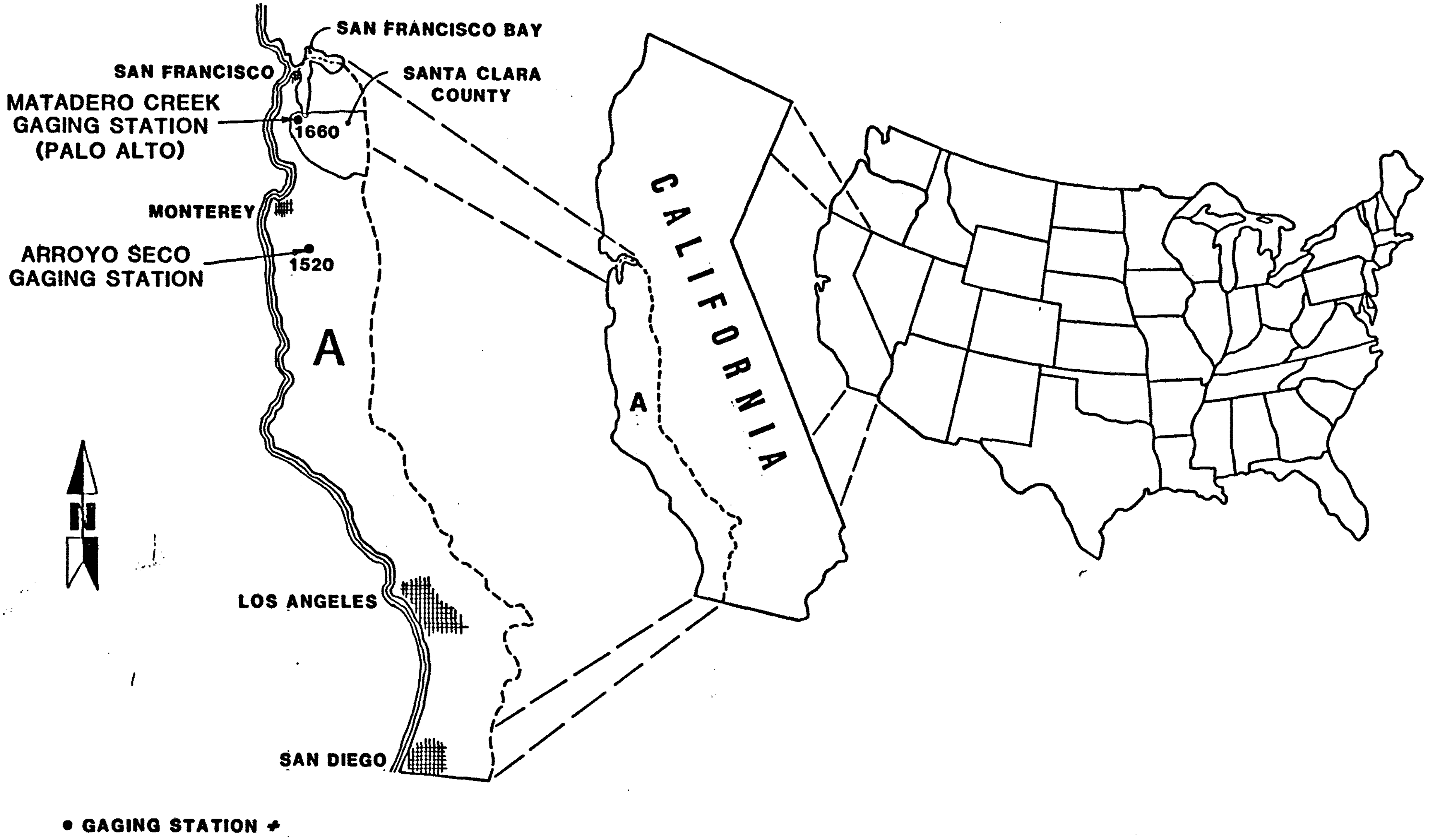
The third comparison technique used by the District is an analysis of the historical streamflow data at the Matadero Creek streamgage compared to data from the immediate hydrometeorological region - that is, the area encompassing Santa Clara County and some surrounding areas which are considered subject to similar storm patterns. This regional analysis permits comparison of the Matadero Creek streamflow record with the streamflow records of gages representing most watersheds in the region. Some 30 such stations were compared for this regional analysis.

One streamflow station in the region with a very long record is on Arroyo Seco Creek, a tributary of the Salinas River south of Salinas. This station has over 100 years of good record and the information in that record is considered to be the most valuable information in any hydrologic study of the region. The Arroyo Seco station is considered by the United States Geological Survey (USGS) and the United States Corps of Engineers (Corps) to be within the same hydrometeorologic region (Region A) as other stations in Santa Clara County, as shown on Figure 4, and was therefore analyzed along with approximately 29 other stations.

The results of this regional analysis are two sets of regional regression equations. One relates the statistics of the peak flows to the mean annual precipitation, watershed area, slope and length of creeks, etc. The other set relates the statistics of the runoff volumes (24-hour, 1-day, 2-day and 3-day) to those same watershed characteristics. The District's regional regression equations are updated (if necessary) as more years of hydrologic data are gathered (every ten to fifteen years). The equations are currently listed in the District's 1976 report, Development of Regional Regression Equations. The report is available from the District upon request.

At the Matadero Creek stream gage location, the 1% flood and volumes that resulted from the application the regional regression equations are as follows (refer to Figure 1 for peak flows and Figure 3 for volumes):

| | | |
|---|---|---|
| Peak flow | : | 2359 cfs |
| Volume | : | 24-hour volume = 912 cfs-24 hours which is equivalent to 1,800 acre-feet or 4.5 inches of excess rainfall. (At the Palo Alto Flood Basin, 4.5 inches of excess rainfall volume is equivalent to 6,600 acre-feet from the three contributing watershed.) |



MAP OF PACIFIC SLOPE BASINS IN CALIFORNIA SHOWING GAGING STATIONS AND FLOOD FREQUENCY REGION A

FIGURE 4

The 4.5 inches of excess rainfall noted above is not a unique or remote event. Such rainfall could come from a 1% storm with approximately 6.5 inches of total 24-hour rainfall. For comparison, the 1% 24-hour storm within this area ranges from 4.2 inches at Santa Clara University to 7.7 inches at Dahl Ranch to 8.5 inches at Stevens Creek and as high as 13.82 inches at Saratoga Gap, at the top of the Santa Cruz Mountains (Reference is made to the State Department of Water Resources Bulletin #195). These are offered as supporting evidence that the 6.5 inches of average rainfall from a 1% storm over the Adobe, Barron, and Matadero Creeks watersheds is very realistic.

## Final Design Flood Flow Value

The final design flow (2359 cfs) adopted for the Matadero Creek gage location is based on the application of the regional regression equations. This value is close to the weighted flow value obtained from the rainfall/runoff analyses, the statistical analyses and the application of the regional regression equations as shown above.

Table 1 is a summary of the results of these three independent techniques. It shows a very close agreement among the results as compared to the weighted average and, therefore, the results of the regional analysis were selected for use in designing the flood control projects on Adobe, Matadero and Barron Creeks.

Tables 2 and 3 show the final design flows on the three creeks including the flows on Adobe Creek. Those values were obtained from the application of the unit hydrograph model (discussed above) to the three watersheds to generate peaks and volumes. Using the results of the regional regression analysis at each location, those peaks and volumes were balanced and the resultant balanced (design flood) flows are routed downstream.

In urban areas the study included the application of the urban hydrology methods (discussed in Ref. 8) which were used to determine flood flows from the pervious and impervious parts of the developed urban areas within the designated watersheds. This entailed an intensive study of storm drain systems and land uses in order to understand the effect of these urban features on the rate and timing of runoff.

On Adobe Creek Table 2 shows that the 1% flow up stream of Barron (start of project), is 3080 cfs (rounded up to

3100 cfs). The corresponding area is equal to 10.84 square miles. This give a unit value of 285 cfs per square mile--a very reasonable value when compared to the unit values on other locations in the area (280 on Barron, 312 on Matadero).

Similarly, Table 3 shows that the 10% flow in Adobe at the same location is 1822 cfs.

For more information about the detailed hydrologic calculations used to generate tables 2 and 3 please refer to Northwest Flood Control Zone Hydrology Report (Bibliography # 3).

## TABLE 1

## SUMMARY OF DISTRICT FLOW VALUES
## MATADERO CREEK @ USGS #1660

| | | 1% Peak Flow c.f.s. | 1%-24 Hr. Volume c.f.s.-24 Hr. | Equivalent Excess Rainfall Inches |
|---|---|---|---|---|
| 1) | Statistical Analysis of Recorded Data | 1945 | | |
| 2) | Statistical Analysis of Recorded and Reconstituted Data | 2310 | 710 | 3.7 |
| 3) | Rainfall-Runoff | 2091 | 909 | 4.5 |
| 4) | Regional Regression | 2359 | 912 | 4.5 |
| 5) | Weighted (2&4) | 2320 | 745 | 3.70 |

Note: The values in this table are based on data collected between 1952 and 1978. See Appendix II for a preliminary checking of these values using the data through 1989.

# TABLE 2

## Recommended Design Flows - 1% Flood
## Matadero-Barron-Adobe Creeks

| | | Peak | 6-Hour | 24-Hour | Area | |
|---|---|---|---|---|---|---|
| Adobe Creek @ City Limits | 1 | 1558 | 1015 | 597 | 4.25 | |
| Adobe Creek U/S Purissima Creek | 2 | 2002 | 1330 | 774 | 5.53 | |
| Adobe Creek @ Foothill Expressway | 3 | 2748 | 1707 | 983 | 7.10 | |
| Adobe Creek @ El Camino | 4 | 2938 | 1910 | 1171 | 8.90 | |
| Adobe Creek U/S Barron Creek | 5 | 3080 | 2126 | 1375 | 10.84 | |
| Barron Creek @ Foothill Expressway | 6 | 762 | 403 | 222 | 1.76 | |
| Barron Creek @ El Camino | 7 | 829 | 492 | 305 | 2.56 | |
| Barron Creek U/S Adobe Creek | 5 | 834 | 552 | 362 | 3.09 | |
| Adobe-Barron @ Bayshore Freeway | 5 | 3914 | 2676 | 1736 | 13.93 | |
| Matadero Creek U/S Deer Creek | 8 | 1455 | 873 | 489 | 3.92 | |
| Deer Creek U/S Matadero Creek | 8 | 744 | 394 | 215 | 1.60 | |
| Matadero Creek @ Foothill Expressway | 8 | 2199 | 1260 | 704 | 5.52 | |
| Matadero Creek @ El Camino | 9 | 2359(2%-2012) | 1486 | 912 | 7.55 | U.S.G.S. |
| Matadero Creek @ Alma Street | 10 | 2545(2%-2207) | 1698 | 1113 | 9.42 | |
| Matadero Creek @ Bayshore Freeway | 11 | 2928 | 2166 | 1557 | 13.57 | |
| Matadero-Barron-Adobe Inflow to Palo Alto Flood Basin | 5,11 | 6842 | 4842 | 3291 | 27.50 | |

# TABLE 3

## Ten Year Flood Flows
## Matadero-Barron-Adobe Creeks

| | | Peak | 6-Hour | 24-Hour | Area |
|---|---|---|---|---|---|
| Adobe Creek @ City Limits | 1 | 821 | 615 | 316 | 4.25 |
| Adobe Creek U/S Purissima Creek | 2 | 1111 | 788 | 399 | 5.53 |
| Adobe Creek @ Foothill Expressway | 3 | 1433 | 977 | 490 | 7.10 |
| Adobe Creek @ El Camino | 4 | 1635 | 1161 | 633 | 8.90 |
| Adobe Creek U/S Barron Creek | 5 | 1822 | 1360 | 778 | 10.84 |
| Barron Creek @ Foothill Expressway | 6 | 323 | 199 | 95 | 1.76 |
| Barron Creek @ El Camino | 7 | 409 | 280 | 159 | 2.56 |
| Barron Creek U/S Adobe Creek | 5 | 455 | 334 | 199 | 3.09 |
| Adobe-Barron @ Bayshore Freeway | 5 | 2277 | 1694 | 977 | 13.93 |
| Matadero Creek U/S Deer Creek | 8 | 641 | 445 | 218 | 3.92 |
| Deer Creek U/S Matadero Creek | 8 | 320 | 198 | 93 | 1.60 |
| Matadero Creek @ Foothill Expressway | 8 | 961 | 639 | 311 | 5.52 |
| Matadero Creek @ El Camino | 9 | 1181 | 844 | 459 | 7.55 |
| Matadero Creek @ Alma Street | 10 | 1378 | 1037 | 608 | 9.42 |
| Matadero Creek @ Bayshore Freeway | 11 | 1794 | 1465 | 928 | 13.57 |
| Matadero-Barron-Adobe Inflow to Palo Alto Flood Basin | 5,11 | 4071 | 3158 | 1904 | 27.50 |

## USE OF HYDROLOGIC PROCEDURES

During the 1960's, when the District was developing its hydrologic methods, much work was done by the District using the Stanford Watershed Model. Under the direction of Ray K. Linsley (Carrol Bradberry and Associates), the model was used to simulate precipitation and streamflow data for some watersheds in the County.

After an initial period of testing it was decided to abandon the Stanford Watershed Model (simulation) approach and adopt the statistical hydrology method that is in use today.

Some of the reasons for abandoning the Stanford Watershed Model were:

1. The results were deemed unusable because they were inconsistent with data obtained from other reliable sources.

2. Some design flows resulting from the model were lower than recorded data.

The USGS research into the use of deterministic, continuous models that are similar to the Stanford Watershed Model indicates that these tend to produce dampened, or lowered, flows or volumes for the larger, less frequent (near the 1% flood) events, and exaggerated flows or volumes for the more frequent floods (Ref. 20, 21).

The Hydrology Committee of the Water Resources Council determined in their 1981 research that less than 1% of all agencies in the U. S. use deterministic modeling (Stanford Watershed Model "SWM" or similar models) in their flood control studies.

Table 4 reproduces the results of that Water Resources Council study.

## TABLE 4

### USE OF HYDROLOGIC PROCEDURES
(in Percent)

| Procedures | Federal Agencies | State Highway | Private Sector | Total |
|---|---|---|---|---|
| Statistical, unit hydrograph (SCVWD) | 73 | 58 | 75 | 69 |
| Empirical Equations | 24 | 38 | 17 | 26 |
| Simulation (Linsley, Kraeger) | 0 | 0 | 1 | less than 1% |
| Other | 3 | 4 | 7 | 4 |

Adapted from Table iii-2, U. S. Water Resources Council, Estimating Peak Flow Frequencies for Natural Ungaged Watersheds, 1981.

Our own investigation, summarized in Table 5, shows that none of the polled flood control agencies in California and elsewhere rely on the Stanford Watershed Model at the present time and there are no plans by them to use it for flood control design applications in the future. San Mateo County used the model at one time to determine the hydrology of the creeks draining the eastern slopes of the Santa Cruz Mountains. The results proved unsatisfactory near Highway 280 and were not used. As described above, in the late 1960's the Santa Clara County Flood Control and Water District used the technique in a contract with Carrol E. Bradberry & Associates, consulting engineers. The results were found to be inappropriate for flood control design (that is, they did not seem to fit with historical records) and were not used. In addition, Santa Barbara County used the SWM for flood forecasting and watershed management, but later abandoned it because of similar observations with regard to the SWM results compared to the historical record.

## TABLE 5

## HYDROLOGIC METHODS USED BY FLOOD CONTROL AGENCIES IN CALIFORNIA (APRIL 1984)

| Flood Control Agency | SCVWD METHOD or Similar |
|---|---|
| Los Angeles County | Yes |
| Alameda County | Yes |
| Contra Costa County | Yes |
| Marin County | Yes |
| Monterey County | Yes |
| Riverside County | Yes |
| San Bernardino County | Yes |
| Santa Barbara County | Yes |
| Santa Clara Valley Water (SCVWD) | Yes |
| San Diego County | Yes |
| San Mateo County | Yes |
| Soil Conservation Service | Yes |
| Corps of engineers | Yes |

# APPENDIX I

## Diagram of Districts Hydrologic Method

# APPENDIX II

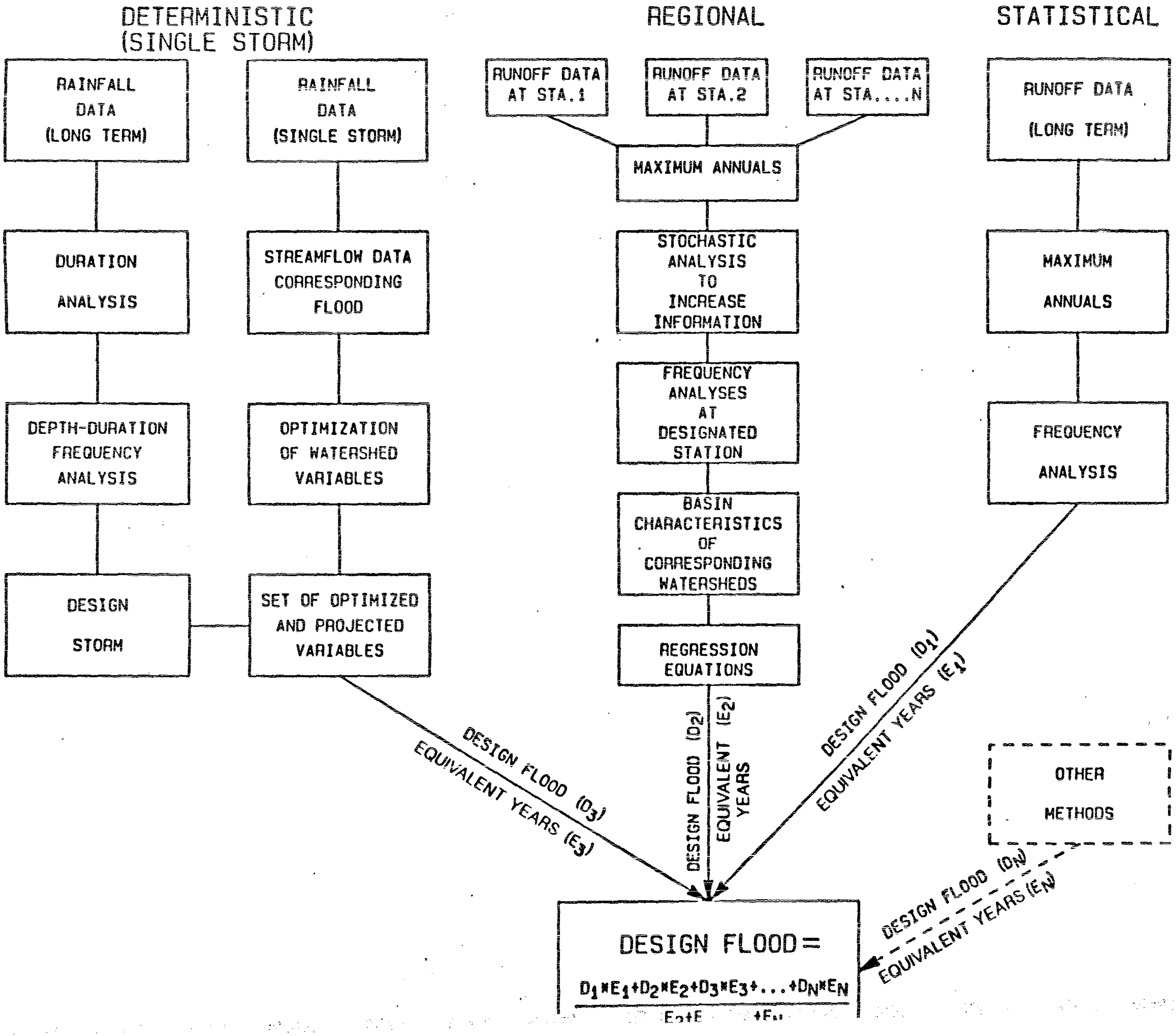
## Analysis Of Streamflow Data From Matadero Creek Gaging Station (1952-1989)

The number of annual streamflow record at USGS gaging station # 1660 (Matadero Creek At El Camino) has increased from 23 years (1952-75) to 37 years (1952-89) since the 1978 update of hydrology methods and the calculation of design flows. This appendix contains two updated preliminary frequency analyses of the data covering the period between 1952 and 1989, using the Log Pearson Type III distribution. The first analysis assumes a regional coefficient of skewness (CS) equal to -0.4 and the other analysis assumes a regional CS equal to -0.6. The resultant 1% flood values of 2020 cfs and 1880 cfs respectively are obtained at the gaged location. These values are approximately equal to the original value of 1945 cfs at the same location (table 1), which makes us confident that the Matadero Creek design flood flows obtained in 1978 are still valid today.

Due to its close proximity to Matadero Creek, and due to the use of a similar hydrologic techniques, the original 1% design flood flow of 3100 cfs on Adobe Creek at the beginning of the project is valid today.

Attached are copies of this preliminary updated frequency analysis.

# DISTRICT METHOD



```
**TITLE CARD(S)**
TT    Matadero creek (USGS #1660) LOG PEARSON TYPE 3 ANALYSIS
TT
TT    C.E. NAHN 4/18/89

**GENERALIZED SKEW**
      ISTN    GGMSE    SKEW
GS    1660     .130    -.60

**SYSTEMATIC EVENTS**
      37 EVENTS TO BE ANALYZED

**END OF INPUT DATA**
ED ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++



 FINAL RESULTS
-PLOTTING POSITIONS-  1660
*****************************************************************
*.....EVENTS ANALYZED......*...........ORDERED EVENTS..........*
*                          *         WATER              WEIBULL  *
* MON DAY  YEAR  FLOW,CFS  *   RANK  YEAR    FLOW,CFS  PLOT POS *
*--------------------------*-------------------------------------*
*  12   6  1952      535.  *     1   1983      1500.     .0263   *
*   3  19  1954       26.  *     2   1973      1200.     .0526   *
*   1  18  1955      170.  *     3   1986      1030.     .0789   *
*  12  22  1955      854.  *     4   1956       854.     .1053   *
*   2  24  1957       28.  *     5   1969       792.     .1316   *
*   4   2  1958      672.  *     6   1967       765.     .1579   *
*   2  16  1959      340.  *     7   1974       713.     .1842   *
*   2   8  1960      139.  *     8   1982       691.     .2105   *
*  11  25  1960       45.  *     9   1978       683.     .2368   *
*   3   5  1962      365.  *    10   1958       672.     .2632   *
*   1  31  1963      641.  *    11   1963       641.     .2895   *
*   1  20  1964      223.  *    12   1980       594.     .3158   *
*   1   5  1965      219.  *    13   1971       576.     .3421   *
*  12  28  1965      311.  *    14   1953       535.     .3684   *
*   1  24  1967      765.  *    15   1968       490.     .3947   *
*   1  30  1968      490.  *    16   1975       405.     .4211   *
*   1  26  1969      792.  *    17   1988       405.     .4474   *
*   3   4  1970      363.  *    18   1987       388.     .4737   *
*  12  20  1970      576.  *    19   1962       365.     .5000   *
*  12  21  1971      246.  *    20   1970       363.     .5263   *
*   2  27  1973     1200.  *    21   1959       340.     .5526   *
*   1   3  1974      713.  *    22   1966       311.     .5789   *
*   3  21  1975      405.  *    23   1979       305.     .6053   *
*  10  10  1975       81.  *    24   1984       286.     .6316   *
*   1   2  1977      114.  *    25   1972       246.     .6579   *
*   1  16  1978      683.  *    26   1964       223.     .6842   *
*   1  14  1979      305.  *    27   1965       219.     .7105   *
*   2  19  1980      594.  *    28   1985       197.     .7368   *
*   1  27  1981      133.  *    29   1955       170.     .7632   *
*   3  31  1982      691.  *    30   1960       139.     .7895   *
*   1  21  1983     1500.  *    31   1981       133.     .8158   *
*  12  11  1983      286.  *    32   1977       114.     .8421   *
*   2   8  1985      197.  *    33   1976        81.     .8684   *
*   2  18  1986     1030.  *    34   1989        77.     .8947   *
*   2  13  1987      388.  *    35   1961        45.     .9211   *
*   1  17  1988      405.  *    36   1957        28.     .9474   *
*  11  23  1988       77.  *    37   1954        26.     .9737   *
*****************************************************************
```

```
-OUTLIER TESTS  -
-----------------------------------------------------------------
LOW OUTLIER TEST
----------------

BASED ON  37 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.650

       0 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF     22.2


-----------------
HIGH OUTLIER TEST
-----------------

BASED ON  37 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.650

      0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF    4358.

-----------------------------------------------------------------


-SKEW WEIGHTING -
-----------------------------------------------------------------
BASED ON  37 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW =    .219
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW =    .130
-----------------------------------------------------------------



 FINAL RESULTS
-FREQUENCY CURVE-  1660
*****************************************************************
*........FLOW,CFS........*              *...CONFIDENCE LIMITS...*
*             EXPECTED   * EXCEEDANCE   *                       *
*  COMPUTED  PROBABILITY * PROBABILITY  *  .05 LIMIT  .95 LIMIT *
*------------------------*--------------*-----------------------*
*     2410.      2650.   *     .002     *     4290.      1590.  *
*     2120.      2290.   *     .005     *     3670.      1420.  *
*     1880.      2010.   *     .010     *     3180.      1280.  *
*     1630.      1720.   *     .020     *     2680.      1130.  *
*     1370.      1430.   *     .040     *     2180.       967.  *
*     1010.      1040.   *     .100     *     1520.       736.  *
*      730.       742.   *     .200     *     1040.       546.  *
*      349.       349.   *     .500     *      462.       266.  *
*      141.       138.   *     .800     *      188.       100.  *
*       82.        78.   *     .900     *      115.        53.  *
*       51.        46.   *     .950     *       75.        30.  *
*       19.        15.   *     .990     *       31.         9.  *
*++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++*
*   FREQUENCY CURVE STATISTICS    *     STATISTICS BASED ON     *
*---------------------------------*-----------------------------*
*  MEAN LOGARITHM          2.4926  *  HISTORIC EVENTS         0  *
*  STANDARD DEVIATION       .4327  *  HIGH OUTLIERS       0      *
*  COMPUTED SKEW          -.8983  *  LOW OUTLIERS        0      *
*  GENERALIZED SKEW       -.6000  *  ZERO OR MISSING     0      *
*  ADOPTED SKEW           -.7000  *  SYSTEMATIC EVENTS      37  *
*****************************************************************


++++++++++

END OF RUN
```

```
**TITLE CARD(S)**
TT   Matadero creek (USGS #1660) LOG PEARSON TYPE 3 ANALYSIS
TT
TT   C.E. NAHN 4/18/89

**GENERALIZED SKEW**
     ISTN   GGMSE    SKEW
GS   1660    .130    -.40

**SYSTEMATIC EVENTS**
     37 EVENTS TO BE ANALYZED

**END OF INPUT DATA**
ED +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++



 FINAL RESULTS
-PLOTTING POSITIONS-  1660
******************************************************************
*.....EVENTS ANALYZED......*..........ORDERED EVENTS..........*
*                          *          WATER              WEIBULL  *
* MON DAY  YEAR  FLOW,CFS  *   RANK   YEAR    FLOW,CFS   PLOT POS *
*--------------------------*--------------------------------------*
*  12   6  1952     535.   *     1    1983     1500.      .0263   *
*   3  19  1954      26.   *     2    1973     1200.      .0526   *
*   1  18  1955     170.   *     3    1986     1030.      .0789   *
*  12  22  1955     854.   *     4    1956      854.      .1053   *
*   2  24  1957      28.   *     5    1969      792.      .1316   *
*   4   2  1958     672.   *     6    1967      765.      .1579   *
*   2  16  1959     340.   *     7    1974      713.      .1842   *
*   2   8  1960     139.   *     8    1982      691.      .2105   *
*  11  25  1960      45.   *     9    1978      683.      .2368   *
*   3   5  1962     365.   *    10    1958      672.      .2632   *
*   1  31  1963     641.   *    11    1963      641.      .2895   *
*   1  20  1964     223.   *    12    1980      594.      .3158   *
*   1   5  1965     219.   *    13    1971      576.      .3421   *
*  12  28  1965     311.   *    14    1953      535.      .3684   *
*   1  24  1967     765.   *    15    1968      490.      .3947   *
*   1  30  1968     490.   *    16    1975      405.      .4211   *
*   1  26  1969     792.   *    17    1988      405.      .4474   *
*   3   4  1970     363.   *    18    1987      388.      .4737   *
*  12  20  1970     576.   *    19    1962      365.      .5000   *
*  12  21  1971     246.   *    20    1970      363.      .5263   *
*   2  27  1973    1200.   *    21    1959      340.      .5526   *
*   1   3  1974     713.   *    22    1966      311.      .5789   *
*   3  21  1975     405.   *    23    1979      305.      .6053   *
*  10  10  1975      81.   *    24    1984      286.      .6316   *
*   1   2  1977     114.   *    25    1972      246.      .6579   *
*   1  16  1978     683.   *    26    1964      223.      .6842   *
*   1  14  1979     305.   *    27    1965      219.      .7105   *
*   2  19  1980     594.   *    28    1985      197.      .7368   *
*   1  27  1981     133.   *    29    1955      170.      .7632   *
*   3  31  1982     691.   *    30    1960      139.      .7895   *
*   1  21  1983    1500.   *    31    1981      133.      .8158   *
*  12  11  1983     286.   *    32    1977      114.      .8421   *
*   2   8  1985     197.   *    33    1976       81.      .8684   *
*   2  18  1986    1030.   *    34    1989       77.      .8947   *
*   2  13  1987     388.   *    35    1961       45.      .9211   *
*   1  17  1988     405.   *    36    1957       28.      .9474   *
*  11  23  1988      77.   *    37    1954       26.      .9737   *
******************************************************************
```

```
-OUTLIER TESTS  -
-----------------------------------------------------------------------
LOW OUTLIER TEST
-----------------

BASED ON  37 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.650

       0 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF     22.2


------------------
HIGH OUTLIER TEST
------------------

BASED ON  37 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.650

      0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF    4358.

-----------------------------------------------------------------------


-SKEW WEIGHTING -
-----------------------------------------------------------------------
BASED ON  37 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW =    .219
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW =    .130
-----------------------------------------------------------------------


 FINAL RESULTS
-FREQUENCY CURVE-  1660
***********************************************************************
*........FLOW,CFS........*              *...CONFIDENCE LIMITS...*
*              EXPECTED   * EXCEEDANCE   *                         *
*  COMPUTED  PROBABILITY * PROBABILITY *  .05 LIMIT  .95 LIMIT *
*-------------------------*-------------*-------------------------*
*      2700.       3010.   *      .002     *      4910.        1750.  *
*      2320.       2540.   *      .005     *      4090.        1540.  *
*      2020.       2190.   *      .010     *      3470.        1370.  *
*      1730.       1840.   *      .020     *      2870.        1190.  *
*      1430.       1500.   *      .040     *      2280.        1000.  *
*      1030.       1060.   *      .100     *      1550.         747.  *
*       730.        743.   *      .200     *      1040.         546.  *
*       343.        343.   *      .500     *       454.         262.  *
*       140.        137.   *      .800     *       187.          99.  *
*        83.         78.   *      .900     *       115.          54.  *
*        52.         48.   *      .950     *        76.          31.  *
*        20.         16.   *      .990     *        33.          10.  *
*+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++*
*   FREQUENCY CURVE STATISTICS    *     STATISTICS BASED ON      *
*---------------------------------*-------------------------------*
*  MEAN LOGARITHM          2.4926  *  HISTORIC EVENTS           0  *
*  STANDARD DEVIATION       .4327  *  HIGH OUTLIERS         0      *
*  COMPUTED SKEW          -.8983  *  LOW OUTLIERS          0      *
*  GENERALIZED SKEW       -.4000  *  ZERO OR MISSING       0      *
*  ADOPTED SKEW           -.6000  *  SYSTEMATIC EVENTS        37  *
***********************************************************************


++++++++++

END OF RUN
```

# BIBLIOGRAPHY

1. Yevjevich, Simon, Review of Methods Used for Estimation of Floods In Santa Clara Valley; Santa Clara Valley Water District, September 1967.

2. Beard, James, Dawdy, Yevjevich & Grigg, Review of Basic Hydrology Methodology for Flood Control, Santa Clara Valley Water District, April 1976.

3. A. D. Saah, Hydrology Documentation For Northwest Flood Control Zone, Santa Clara Valley Water District, July 1976.

4. Carrol Bradberry & Associates, Synthesized Streamflow Data, Santa Clara County, 1964.

5. Carrol Bradberry & Associates, Hydrologic Atlas, Santa Clara County, 1964.

6. U. S. Water Resources Council, Guidelines for Determining Flood Flow Frequency, Bulletins 17 and 17B.

7. Saah, Talley and Sanchez, Development of Regional Regression Equations, Santa Clara Valley Water District (Draft Report), March 1976.

8. Saah, Watson, Urban Hydrology Methodology, Paper presented at the National Symposium on Urban Hydrology, Santa Clara Valley Water District, March 1976.

9. U. S. Army Corps of Engineers, HEC-1 Flood Hydrograph Package, The Hydrologic Engineering Center, California, 1973.

10. Beard, L. R., Statistical Methods in Hydrology, U. S. Army Corps of Engineers, Civil Works 1. P. CW151, 1962.

11. Linsley, Kreager Associates, Hydrologic Analysis of the Palo Alto Flood Basin, April 1984.

12. EPA - 60019-80-015, Users Manual For Hydrological Simulation Programs - FORTRAN (HSPF), April 1980.

13. U. S. Army Corps of Engineers, HEC Program 723-X6 - L2350, Regional Frequency Computations, 1972 Update.

14. V. T. Chow, Handbook of Applied Hydrology, 1964.

15. Langbein, W. B., Annual Floods and Partial Duration Series, Trans. W. G. W. Vol. 30, 1949.

16. Matalas, N. & B. Jacobs, A Correlation Procedure for Augmenting Hydrologic Data, U.S.G.S. Paper # 434 E, 1964.

17. Myron Feiring, Used of Correlation to Improve Estimates of the Mean and Variance, U. S. G. S. Paper 434C.

18. U. S. Army Corp of Engineers, HEC Program # 704-G1 - L202., Multiple Linear Regression.

19. Jennings and Benson, Frequency Curves for Annual Flood Series with Incomplete Data. U.S.G.S., 1969.

20. Wilbert O. Thomas Jr., An Evaluation of Flood Frequency Estimates Based on Rainfall/Runoff Modeling, Water Resources Bulletin, AWRA, April 1982.

21. Lichty and Liscum, A Rainfall-Runoff Modeling Procedure for Improving Estimates of T-Year Annual Flood For Small Drainage Basins. U.S.G.S. W.R.1. 78-7, August 1978.

22. Water Resources Council, Estimating Peak Flow Frequencies For Natural Ungaged Watersheds, A Proposed Nationwide Test, Hydrology Committee, 1981.

23. Astrue, Sutcliffe & McNeely, Report on Flooding and flood Related Damage January 1, to April 30, 1984, October

24. Salas, Yevjevich, Boas, Delleur, Schaake et. al., Lecture Notes for the Computer Workshop in Statistical Hydrology, Colorado State University, July 1978.

25. FEMA - 37, Flood Insurance Study, Guidelines and Specifications For Study Contractors, FEMA, September 1982.

26. W. R. C., A Unified National Program for Flood Plan Management, July 1976.

27. Department of Water Resources, Rainfall Analysis for Drainage Design, Bulletin #195, October 1976.

28. Other office reports, computations and computer printouts - available from District library.

# APPENDIX C

# GEOTECHNICAL ASSESSMENT

Prepared by CH2M Hill

# GEOTECHNICAL ASSESSMENT
# PROPOSED ADOBE CREEK
# PHASE IV IMPROVEMENTS
# PALO ALTO, CALIFORNIA

Prepared for

Santa Clara Valley Water District

by

CH2M HILL CALIFORNIA, INC.
2107 N. First Street, Suite 350
San Jose, California 95131
408/436-4909

August 1989

BERNARD ANDERSON
No. GE 96

## CONTENTS

Page

Introduction 1
Purpose and Scope 1
Limitations 1
Project Description 3
Existing Information 3

Geotechnical Setting 7
Regional Geology 7
Seismicity 7
Subsurface Conditions 8

Impacts 9
Short-Term Impacts 9
Long-Term Impacts 14
Potentially Impacted Properties and Structures 15

Mitigation 19
Pre-Construction Survey 19
Monitoring 19
Protect Existing Structures 20
Shoring and Bracing System 20
Repair/Replace Impacted Structures 21

References 22

## TABLES

1 Field Reconnaissance-Properties Visited 6
2 Active Faults 14
3 Potentially Impacted Houses 16
4 Potentially Impacted Structures (other than houses) 17

## FIGURES

1 Project Location 2
2 Typical Channel Configuration 4
3 Typical Temporary Shoring and Bracing System 10
4 Potential Ground Movement 12

## INTRODUCTION

The Santa Clara Valley Water District (SCVWD) has prepared preliminary engineering drawings (dated December 23, 1988) for proposed channel improvements to Adobe Creek between Charleston Road and approximately 800 feet upstream of the Southern Pacific Transportation Company (SPTC) railroad bridge in Palo Alto, California. The site location is shown in Figure 1. Generally, these improvements include converting the existing trapezoidal channel into a U-frame channel. Residential houses, swimming pools, fences, and other small structures have been built along both sides of Adobe Creek. An Environmental Impact Report (EIR) will be prepared to address the potential impacts of the proposed creek modifications.

## PURPOSE AND SCOPE

This report presents the results of our geotechnical evaluation for the proposed Adobe Creek improvements. The purpose of the evaluation is to assess the potential geotechnical impacts on the surrounding properties as a result of the proposed construction. We understand that the results of this evaluation will be included in the EIR, and that this report will be included as an appendix to the EIR. Our scope of work consisted of the following tasks:

- Engineering evaluation of potential short-term impacts. This task included estimating the potential ground movement from the proposed excavation, identifying structures that may be affected by the construction, checking City of Palo Alto building files for information about these structures, visiting the site, and evaluating the possible damage to the structures.
- Engineering evaluation of potential long-term impacts, including earthquake-related hazards.
- Recommendations for mitigation of potential impacts, both short-and long-term.
- Preparation of geotechnical assessment report.

## LIMITATIONS

This report has been prepared for the exclusive use of the SCVWD for specific application to the project described in this report. Our site evaluation was performed in accordance with generally accepted geotechnical engineering

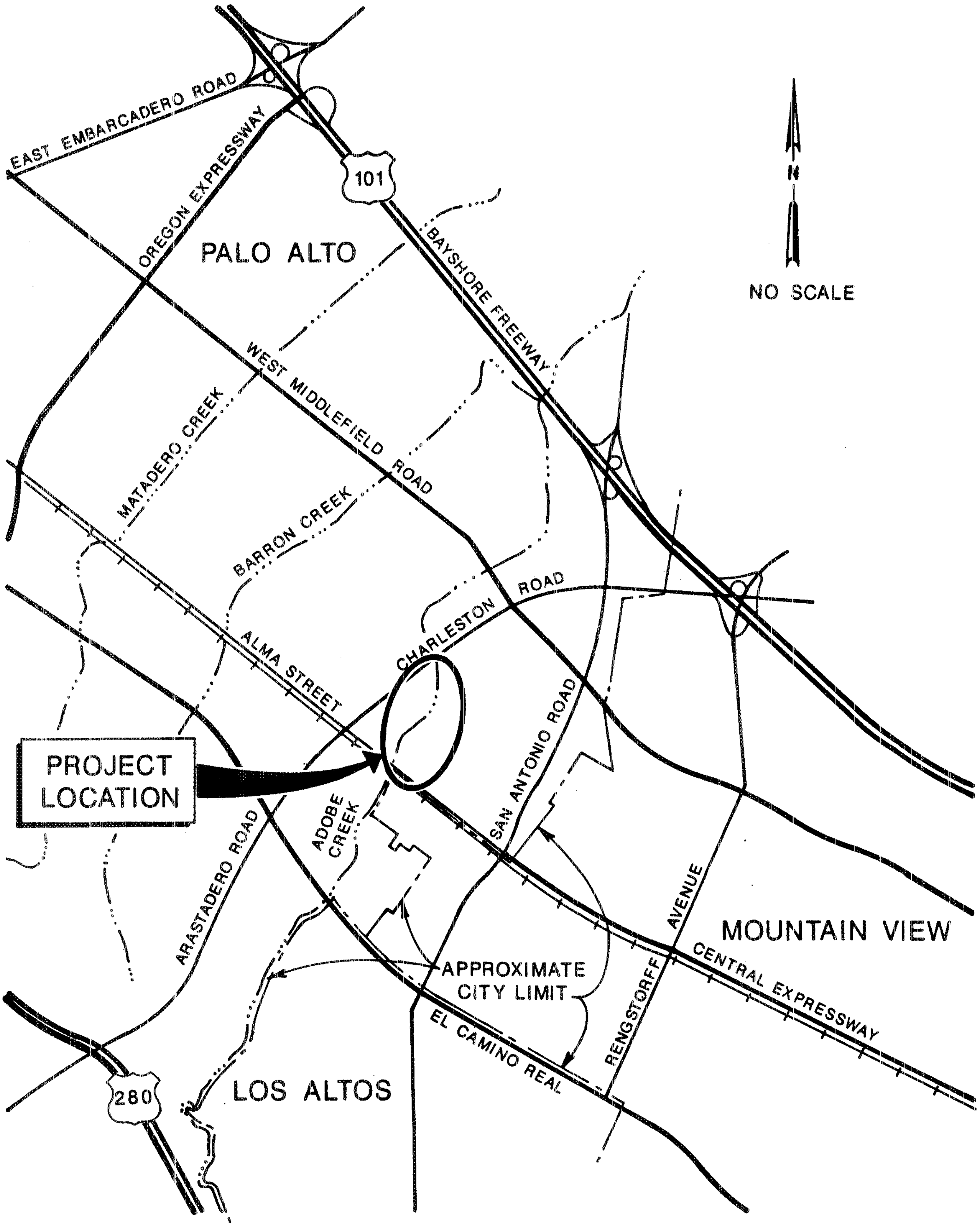


FIGURE 1
PROJECT LOCATION

practice. CH2M HILL makes no warranties, expressed or implied, regarding the findings or recommendations presented herein.

The evaluation presented in this report is based in part upon data obtained from soil borings made by others. CH2M HILL makes no warranties, expressed or implied, about the accuracy or quality of the existing information. Data from the existing borings, including groundwater measurements, indicate subsurface conditions only at the specific locations and times, and only to the depths explored. They do not necessarily reflect variations that may exist at other locations or at other times.

During construction, new or additional information may become available regarding the geotechnical conditions or the surrounding structures. This information should be supplied to CH2M HILL for review. Based on the review, CH2M HILL reserves the right to revise the conclusions and professional judgments presented in this report.

## PROJECT DESCRIPTION

Adobe Creek between Charleston Road and the vicinity of the SPTC bridge currently flows through a concrete-lined trapezoidal shaped channel. SCVWD proposes to improve the entire creek length with a U-frame channel. The typical channel configuration is shown in Figure 2. The U-frame channel will vary in dimension along the creek length, but will be approximately 17 to 20 feet wide and about 11 to 13 feet deep. It appears that the U-frame channel wall is about 3 to 5 feet higher than the surrounding ground. The existing Adobe Creek right-of-way is 30 feet wide below Alma Street, and 50 feet wide above Alma Street. Construction of the U-frame channel will require demolition and removal of the existing concrete channel lining, deepening the creek in the vicinity of Alma Street, excavating portions of the channel side slopes, and constructing the channel bottom slab and walls. We anticipate that shoring and bracing of the channel walls will be required during construction of the new channel. After the permanent wall is complete, backfill will be placed behind the channel walls to level the ground surface, and the temporary shoring and bracing removed.

## EXISTING INFORMATION

A geotechnical report was prepared by United Soil Engineering, Inc. (January 1988) to determine the existing geotechnical conditions along the proposed creek improvements. The geotechnical evaluation consisted of drilling 11 borings to

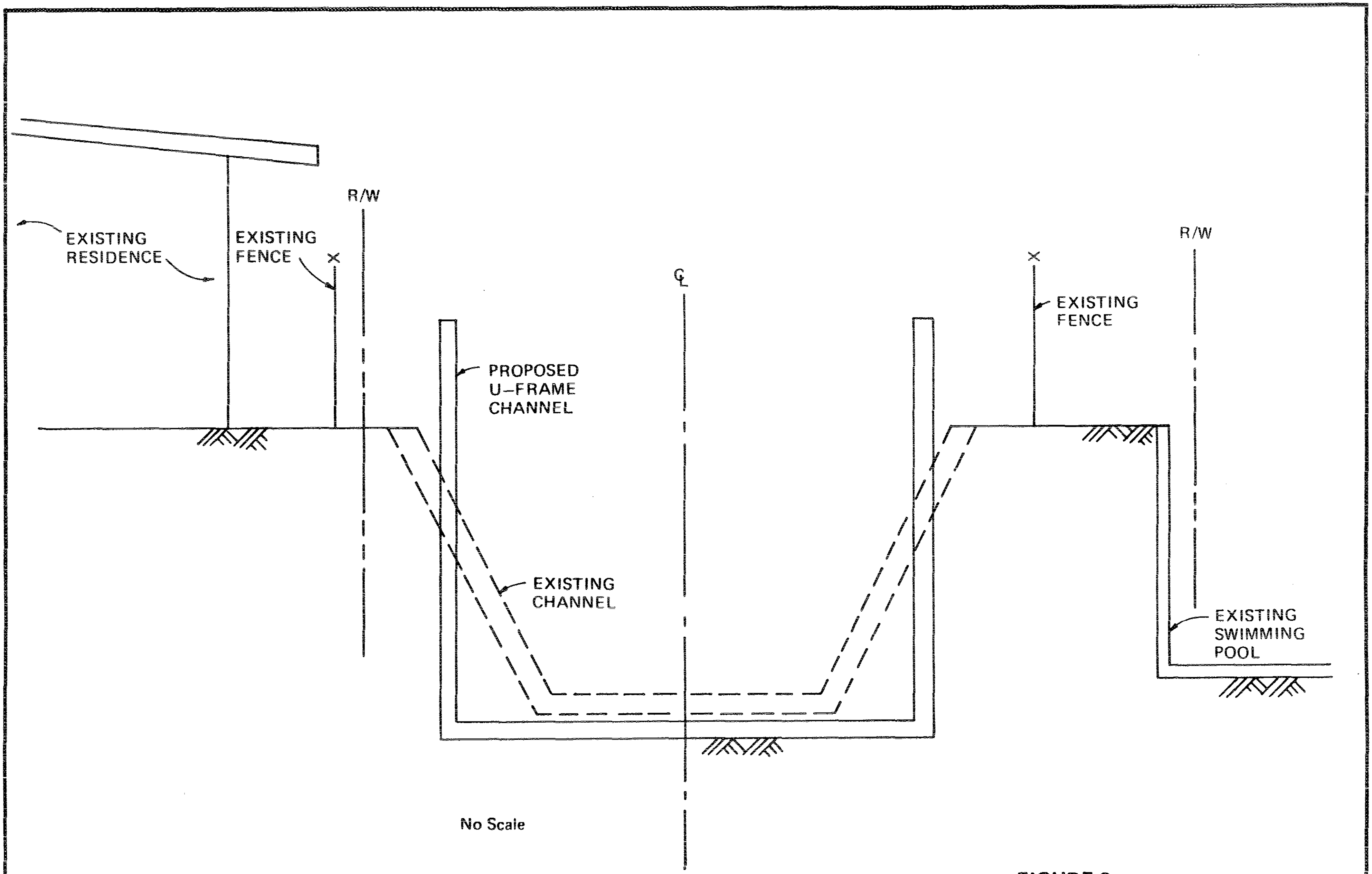


FIGURE 2
TYPICAL CHANNEL CONFIGURATION
PROPOSED ADOBE CREEK PHASE IV IMPROVEMENTS
PALO ALTO, CALIFORNIA

CH2M HILL

depths from 20 to 25 feet along the creek, performing laboratory analyses on selected soil samples, and providing engineering recommendations for the design of the project. Four of these 11 borings (B-6 through B-9) are within the project area. Two other geotechnical reports were prepared in the project vicinity for SCVWD, one by Wahler Associates (February 1988) for the Charleston Road bridge, and the other by CH2M HILL (July 1988) for Adobe Creek modifications at Alma Street.

The City of Palo Alto building department files were searched for information pertaining to the design and construction of potentially impacted structures along the creek. In general, the information available from the building department was sparse and of little use to this geotechnical evaluation.

As part of the preliminary work performed for this project, SCVWD surveyed the channel and surrounding properties. The survey notes were available for this evaluation, and include the locations of houses, fences, pools, trees, and other miscellaneous structures and utilities.

CH2M HILL conducted a field reconnaissance on March 30, and May 11, 1989. The purpose of this field visit was to visually assess the potentially impacted structures. A list of the properties visited is given in Table 1. In all, 20 properties were visited.

SF07/002.50

# Table 1
# FIELD RECONNAISSANCE-PROPERTIES VISITED PROPOSED ADOBE CREEK IMPROVEMENTS

| Name | Address | Approximate Creek Station |
|---|---|---|
| Becker | 455 El Capitain Pl. | 198+00 |
| Justice | 465 El Capitain Pl. | 198+00 |
| Liang | 3990 Duncan Place | 199+00 |
| Wheeler | 3956 Nelson Court | 201+00 |
| Lindholm | 411 Adobe Place | 203+00 |
| Fung | 3934 Duncan Place | 205+00 |
| Morris | 345 Creekside Drive | 206+00 |
| Olmstead | 331 Creekside Drive | 206+50 |
| Preston | 3918 Duncan Place | 207+00 |
| Barnes | 317 Creekside Drive | 207+00 |
| Morrison | 3902 Duncan Place | 208+50 |
| Wall | 291 Creekside Drive | 209+00 |
| Haines | 281 Creekside Drive | 210+00 |
| Grandburg | 3875 Mumford Place | 210+00 |
| Straehnke | 3895 Mumford Place | 211+50 |
| Brann | 251 Creekside Drive | 212+00 |
| Wenner ("Tract 4927") | 135 Green Meadow Way | 219+00 |
| Cooke ("Tract 4927") | 131 Green Meadow Way | 219+00 |
| Kennedy ("Tract 4927") | 119 Green Meadow Way | 219+00 |
| Drapkin | 3943 Alma Street | 219+00 |

SF07/003.50/gmb

# GEOTECHNICAL SETTING

## REGIONAL GEOLOGY

The project is located in the northern portion of the Santa Clara Valley. Santa Clara Valley is flanked on the west by the Santa Cruz Mountains and on the east by the Diablo Range. The Bay and connecting valley to the south lie in a structural trough formed by downwarping and faulting. This trough came into existence late in the Pliocene Epoch (a few million years ago) and over the last one million years has been nearly filled with marine sediments and alluvial materials derived from the surrounding hills.

In the Santa Clara Valley, the upper alluvial deposits are generally divided into the Plio-Pleistocene age Santa Clara Formation (about 10,000 to 2 million years ago) and younger valley alluvium that is late Pleistocene to recent in age (younger than 10,000 to 50,000 years). These two alluvial units are very similar in texture and have the same general origin, mainly as alluvial fan deposits.

The Santa Clara Formation in the project area consists of unconsolidated, poorly sorted, irregularly bedded material ranging in grain size from clay to gravel. The younger valley alluvium consists of unconsolidated deposits of gravel, sand, silt, and clay. These deposits take the form of coalescing alluvial fans and were deposited by the many streams that drain from the Santa Cruz and Diablo Mountains and meander across the valley to the Bay. Because of their sequence of deposition, folding, faulting, and erosional history, the younger valley alluvium deposits are an irregular sequence of meandering, permeable stream-channel deposits separated by less permeable silt and clay.

## SEISMICITY

The San Francisco Bay area is recognized as one of the most seismically active regions in the United States. The significant earthquakes that occur in this area are generally associated with crustal movements along well-defined, active faults. The closest active faults of concern to this project include the San Andreas, the Calavaras, and the Hayward faults. Since each of these faults has had a major historic earthquake and has continuing micro-seismic activity due to fault creep, they should be considered capable of future large magnitude earthquakes. The site is located within Zone 4 of the Uniform Building Code seismic design provisions.

## SUBSURFACE CONDITIONS

### SOIL

According to a review of the existing and available geotechnical data at the site, it appears that the site is underlain by alluvial material. According to the United Soil Engineering report, "the surface soils were black to brown and trended from silty to sandy. These soils are laterally continuous and extended down to 10 feet. From 10 to 20 feet, a reddish-brown to brown, gravelly sandy clay was penetrated. Although this section was consistent, minor changes in the percentage of sands and gravels occurred." The soil described in the other two geotechnical reports (Wahler Associates and CH2M HILL) appears to be similar to the soil encountered by United Soil Engineering along the channel.

### GROUNDWATER

Groundwater was not encountered in United Soil Engineering borings B-6 through B-9 to the maximum depth drilled of 20 feet below the top of the embankment. In the CH2M HILL piezometers installed near the SPTC tracks, groundwater was encountered 17.5 feet below the ground surface (approximately elevation 20). At Charleston Road, groundwater was encountered 9.5 feet below the ground surface (approximately elevation 9) in the Wahler Associates boring. For purposes of this evaluation, it can be assumed that groundwater is at or below the bottom of the existing channel.

SF07/002A.50

# IMPACTS

## SHORT-TERM IMPACTS

Short-term impacts generally fall into two categories: construction nuisance, such as dust and noise, and those impacts associated with the effects of ground movement caused by the proposed construction. We anticipate that noise and some dust will be generated during demolition of the existing channel. Noise would also result from pile driving operations, compaction equipment, and other construction procedures. The City of Palo Alto noise ordinance requires a variance for pile driving.

Ground movement could cause settlement of the ground surface adjacent to the channel. This settlement could result in architectural or structural damage to structures such as houses, sheds, and patios. In addition, lateral ground movement could cause damage to the buried structures and vegetation such as the swimming pools, utilities, and tree roots. Lateral and vertical ground movement during construction of the proposed U-frame channel could potentially result primarily from three ways: lateral movement of the temporary shoring and bracing, vibration of the ground from pile driving during installation of the shoring system, and subsidence caused by construction dewatering.

### SHORING AND BRACING

The temporary shoring and bracing required for construction of the U-frame channel is probably the most important element in the potential for ground movement. Typical temporary retaining systems are shown in Figure 3. It is our understanding that the shoring and bracing system would most likely consist of a cantilever drilled pier wall. Bulging or lateral movement of the wall would cause the soil behind the wall to slump toward the wall, thereby causing lateral movement of the soil in addition to settlement at the ground surface. Virtually all temporary retaining systems permit some ground movement. Excessive wall movement could be caused by an inadequately designed shoring and bracing system, poor quality workmanship of the wall, or accidental failure of the wall.

According to the existing soil borings, the soil behind the wall is a stiff, silty or sandy clay. Based on empirical correlations between ground surface settlement and distance from the excavation (Peck, 1969) for "sand and soft to hard clay, average workmanship," the ground surface settlement due to flexure of the shoring and bracing system will be less than or equal to approximately one percent of the excavation depth at the excavation wall, and tapers off to zero at a distance of approximately twice the excavation

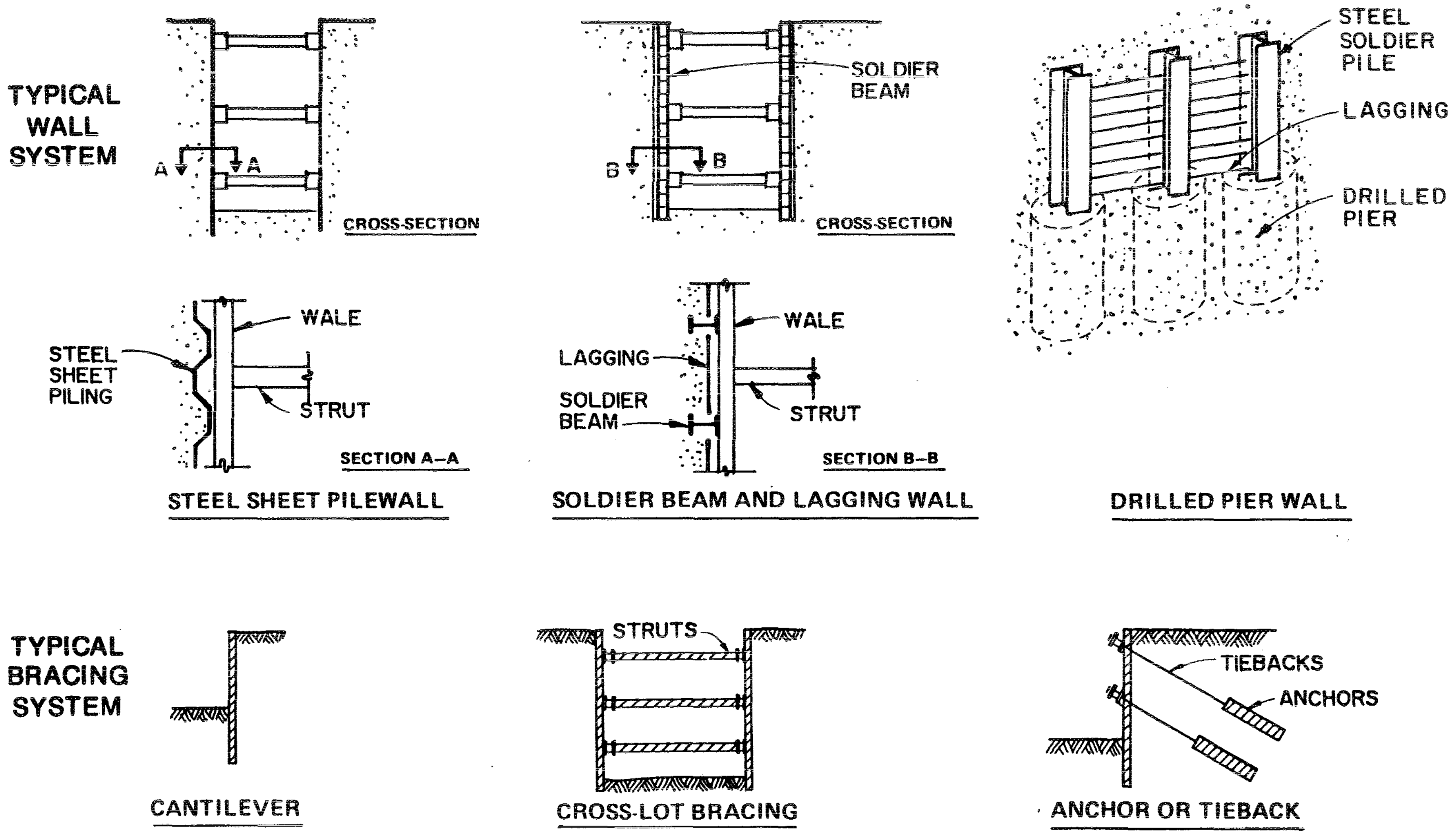


FIGURE 3
TYPICAL TEMPORARY SHORING AND
BRACING SYSTEMS
PROPOSED ADOBE CREEK PHASE IV IMPROVEMENTS
PALO ALTO, CALIFORNIA

depth from the wall. Therefore, for the project excavation depth of about 10 feet, the settlement will be a maximum of about one inch near the wall, and taper off to zero at about 20 feet from the wall. The potential vertical ground movement is shown in Figure 4 for a braced excavation. A relatively flexible cantilever wall (such as steel sheet piles) would probably permit more ground movement.

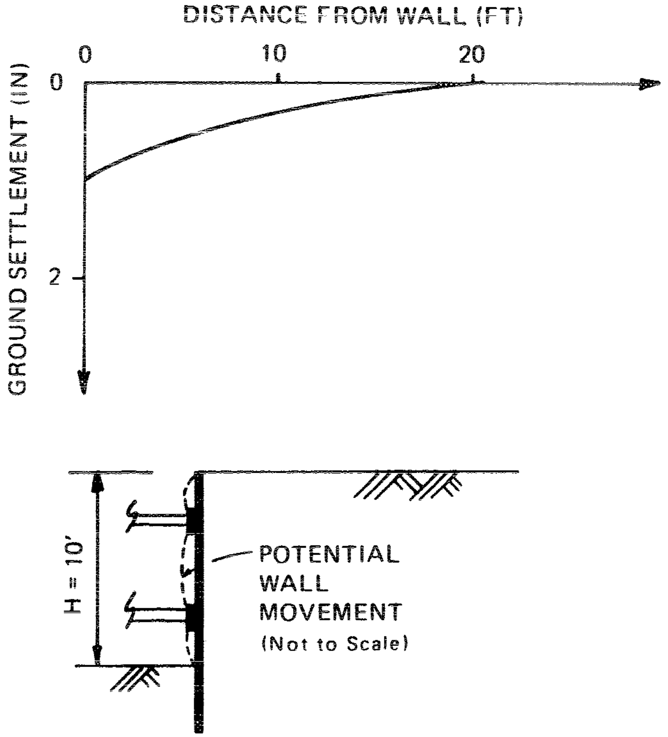
The lateral ground surface movement can be related to the maximum lateral wall movement. The maximum lateral wall movement is approximately 0.5 percent of the excavation depth (Mana and Clough, 1981) For the soil conditions at the site, the lateral ground surface movement is approximately equal to the maximum lateral wall movement at a distance of about 1.5 times the excavation depth (Clough, 1985). Therefore, for a 10 foot deep excavation, the maximum lateral ground surface movement will be approximately 1/2 inch at a distance of 15 feet from the wall. The potential lateral ground movement is shown in Figure 4 for a braced excavation. As with the vertical ground movement, the type of wall and bracing determines the amount of movement.

The approximations of ground movement given above are based on the assumption that the excavation is shored along its entire length (i.e., no cut-back or open slopes), and that the wall is adequately designed and constructed. Ground movement may be greater if the wall is of inadequate stiffness, the bracing is inadequate or its installation is delayed, an excessive surcharge (such as machinery or supplies) is placed adjacent to the excavation, the excavation is left open for a long period of time, and due to other factors such as adverse weather and varying soil conditions.

The "permissible" amount of ground movement, i.e., the largest ground movement that could occur without damaging houses or other structures, is highly dependent on the type and condition of the structure, and the local soil conditions. Each potentially impacted structure will need to be analyzed on a case-by-case basis to establish ground movement criteria.

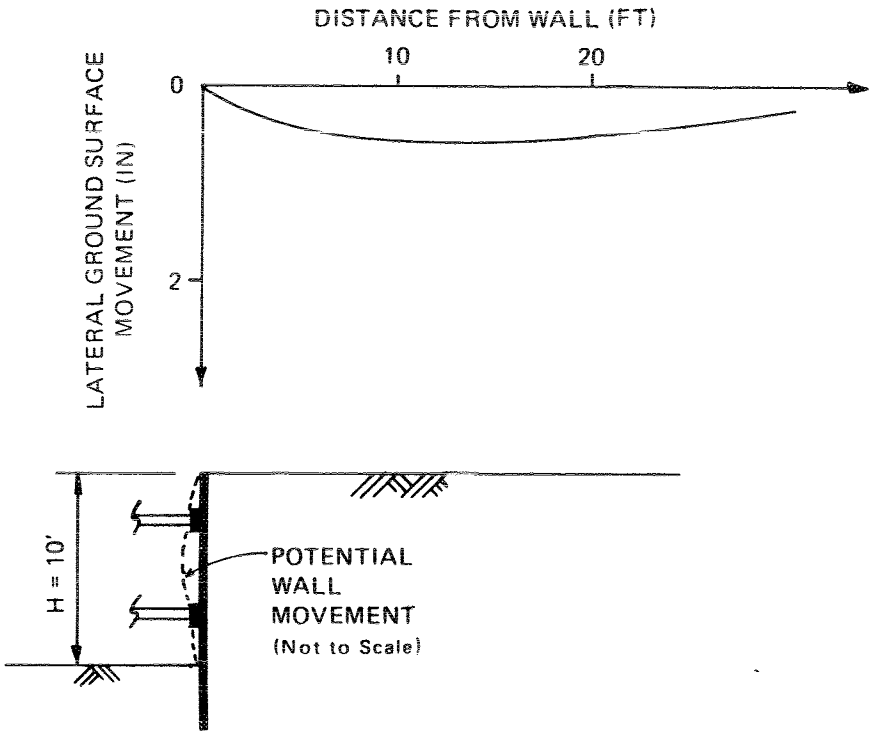
## PILE DRIVING

The shoring and bracing system may consist of driven sheet piles or soldier piles and lagging. Installation of the driven piles will cause noise and vibrations in the surrounding ground. It may be difficult to obtain a noise ordinance variance from the City of Palo Alto. In loose to medium dense sandy soil, the vibrations tend to densify the soil and thus cause ground surface settlement. From the



POTENTIAL VERTICAL GROUND MOVEMENT

*(AFTER PECK, 1969)*



POTENTIAL LATERAL GROUND MOVEMENT

*(AFTER CLOUGH, 1985)*

**FIGURE 4**
**POTENTIAL GROUND MOVEMENT**
**PROPOSED ADOBE CREEK PHASE IV IMPROVEMENTS**
**PALO ALTO, CALIFORNIA**

existing borings, it does not appear that there are soil deposits at the site that are susceptible to this type of densification. However, there may be loose lenses or layers of sand that were not encountered during drilling. Also, any man-made sandy fill, such as utility line or swimming pool wall backfill may be susceptible to vibration densification.

The pile driving vibrations may cause direct architectural or structural damage to surrounding structures, and may be a nuisance to residents. There are several correlations between the vibration intensity (as measured by particle velocity) and various threshold limits. According to Wiss (1974), the vibrations become "unpleasant" to humans at about 0.2 inch/second (in./sec), and "objectionable" at about 0.6 in./sec. From an architectural standpoint, the recommended safe vibrational level for residences is 2 in./sec. Residential plaster cracks at about 5 in./sec.

The vibration intensity caused by pile driving depends on the type of pile driving equipment and on the soil conditions at the site. Driving sheet piles with a vibratory pile driver at the project site could induce ground vibrations on the order of 5 in./sec. at about 5 feet from the pile (Wiss, 1974). The vibration intensity will decrease with distance from the pile. Therefore, buildings and other structures within 10 feet of the pile driving operation may be subject to damaging vibrations. Within about 100 feet of the pile driving, people may find the vibrations objectionable.

## DEMOLITION

We anticipate that demolition of the existing concrete channel will be done with a backhoe-mounted jackhammer or other heavy equipment. The demolition will most likely cause dust, noise, and vibration to the surrounding areas. The vibration levels caused by the demolition are difficult to predict, but could be on the order of 0.5 in./sec at about 5 feet from the demolition (Wiss, 1974).

## DEWATERING

Depending on the actual groundwater level encountered during construction, excavation dewatering may or may not be required. We anticipate that the groundwater level is near the base of the existing channel, and that some dewatering will be required. According to SCVWD personnel, dewatering was required at the Charleston Road bridge construction. Settlement monuments placed about 5 feet from the construction area showed settlement of about 1/2 inch within 2 or 3 months as a result of the dewatering.

## LONG-TERM IMPACTS

### SEISMIC HAZARDS

Because the project area is near active faults, it is reasonable to assume that the project area will be subjected to strong ground shaking from at least one moderate to severe earthquake during the life of the project. Table 2 lists the distance to the major faults from the project area, along with magnitude estimates for the maximum credible earthquake and peak horizontal ground accelerations at the site.

Table 2
ACTIVE FAULTS
PROPOSED ADOBE CREEK IMPROVEMENTS
Palo Alto, California

| Fault | Distance From Site (miles) | Est. Earthquake Richter Magnitude[a] | Est. Ground Acceleration At Site[b] |
|---|---|---|---|
| San Andreas | 8 Southwest | 8.25 | 0.45 g |
| Hayward | 10.6 Northeast | 7.5 | 0.37 g |
| Calaveras | 15.67 Northeast | 7.5 | 0.30 g |

---

[a] From Greensfelder, 1973
[b] Based on correlations by Seed and Idriss, 1982

The fault zone of primary concern to this project is the San Andreas. It should be noted that the project area is subject to the same seismic risk regardless of whether the creek improvements are made or not.

No loose saturated clean sand was noted in any of the existing boring logs at the site. Therefore, liquefaction of the subsurface material beneath the proposed channel improvements is unlikely due to the generally fine-grained, cohesive nature of the subsurface soil.

### SETTLEMENT

As with the temporary shoring and bracing system, ground movement could occur if the permanent channel wall rotated inward toward the channel. If the backfill behind the channel wall was improperly compacted, settlement could occur over the long term.

## POTENTIALLY IMPACTED PROPERTIES AND STRUCTURES

It is not within the scope of this work to predict exactly how each potentially impacted structure will respond to the proposed construction. In this section, potentially impacted structures will be listed and briefly discussed. Only important structures will be addressed; lesser structures, such as fences or trees, will not be discussed. The information presented in this section is based on the project aerial photographs and our field reconnaissance. The potentially impacted houses are listed in Table 3, along with distance to the channel top-of-bank and any significant features. Other potentially impacted structures such as pools, sheds, and patios are listed in Table 4.

### HOUSES

There are 24 houses within the potential zone of settlement (20 feet from the channel top-of-bank). As can be seen in Table 3, several houses are close to the proposed construction. Several houses have overhanging eaves adjacent to the channel that could obstruct the proposed construction. There are two condominium buildings within the settlement zone at the intersection of Adobe Creek and Alma Street.

The typical residence along Adobe Creek is referred to as an "Eichler" home. These structures consist of a concrete slab-on-grade foundation and a wood-framed superstructure. Many of the houses have large plate glass windows and sliding glass doors. The houses were constructed with radiant heating systems, consisting of copper or galvanized steel tubing embedded in the concrete slab-on-grade. To provide heat, hot water circulates through the tubing.

Ground settlement could cause cracking of the concrete slab-on-grade foundation system, and possibly architectural cracks in the interior walls or exterior siding. Structural damage to the wood frame superstructure is unlikely. Damage to the slab-on-grade may cause rupturing of the radiant heat tubing thus making the heating system inoperative. This could lead to additional settlement if the subgrade below the slab-on-grade became saturated from leaks in the heating system.

### SWIMMING POOLS

Eight swimming pools are within the zone of potential settlement. Seven of the pools are concrete lined, either rectangular, oval, or kidney-shaped. Potential impacts to the concrete or masonry pools include rotation or tilting of the pool walls leading to the cracks in the masonry. Fiberglass pool walls may also crack due to shifting and rotating of

## Table 3
## POTENTIALLY IMPACTED HOUSES
## PROPOSED ADOBE CREEK IMPROVEMENTS
## Palo Alto, California

| Name | Address | Approx. Creek Station | Approx. Distance From Exist. Top-of-Bank (ft) | Field Visit | Comments |
|---|---|---|---|---|---|
| Justice | 465 El Capitain Pl. | 198+00 | 4 | * | 2-ft overhang |
| Becker | 455 El Capitain Pl. | 198+00 | 7 | * | 2-ft overhang |
| Liang | 3990 Duncan Pl. | 199+00 | 9 | * | |
| Van de Put | 3954 Nelson Ct. | 200+50 | 3 | | |
| Wheeler | 3956 Nelson Ct. | 201+00 | 5 | * | 2-ft overhang |
| Lindholm | 411 Adobe Pl. | 203+00 | 6 | * | 2-ft overhang |
| Fung | 3934 Duncan Pl. | 205+00 | 14 | * | Addition to house closest to creek. |
| Morris | 345 Creekside Dr. | 206+00 | 10 | * | Cracks in floor slab - radient heat operable. |
| Olmstead | 331 Creekside Dr. | 206+50 | 10 | * | 2-ft overhang |
| Barnes | 317 Creekside Dr. | 207+00 | 2 | * | 2-ft overhang |
| Morrison | 3902 Duncan Pl. | 208+50 | 8 | * | |
| Wall | 291 Creekside Dr. | 209+00 | 6 | * | |
| Haines | 281 Creekside Dr. | 210+00 | 6 | * | Baseboard heat - not in slab, 2-ft. overhang. |
| Vanderiet | 271 Creekside Dr. | 211+00 | 2 | | |
| Straehnke | 3895 Mumford Pl. | 211+50 | 14 | * | |
| Brann | 251 Creekside Dr. | 212+00 | 11 | * | 2-ft overhang |
| Elspas | 130 Ely Pl. | 217+00 | 8 | | |
| Okner | 207 Creekside Dr. | 214+50 | 15 | | |
| Gilberg | 209 Creekside Dr. | 215+00 | 14 | | |
| Wenner ("Tract 4927") | 135 Green Meadow Way | | 5 | * | 2-ft overhang |
| Kennedy ("Tract 4927") | 119 Green Meadow Way | 219+00 | 6 | * | 6-ft overhang |
| Drapkin | 3943 Alma St. | 219+00 | 15 | * | |
| Stietzel | 239 Whitclem Ct. | 224+50 | 18 | | |

## Table 4
## POTENTIALLY IMPACTED STRUCTURES (OTHER THAN HOUSES)
## PROPOSED ADOBE CREEK IMPROVEMENTS
## Palo Alto, California

| Name | Address | Approx. Creek Station | Type of Structure | Approx. Distance From Existing Creek Top-of-Bank (ft.) |
|---|---|---|---|---|
| Justice | 465 El Capitain Pl. | 198+00 | Small office, separate from house, along fence | 2 |
| Kirkeby | 3998 Duncan Pl. | 198+00 | Pool 7-ft wide patio between pool and channel aluminum shed | 4 |
| Liang | 3990 Duncan Pl. | 199+00 | Swimming pool-plastic liner with sand backfill 30ftx12ftx8ft pool pump, fittings, underground pipes along fence concrete patio | 8 |
| Preston | 3918 Duncan Pl. | 207+00 | Concrete-lined pool concrete patio between pool and fence | 10 |
| Morrison | 3902 Duncan Pl. | 208+50 | Concrete-lined pool concrete patio to fence, fence supports small wood overhang | 6 |
| Grandberg | 3875 Mumford Pl. | 210+00 | Concrete-lined pool 30ftx15ftx8ft 3-ft. wide patio on channel side of pool, piping and equipment | 15 |
| Berwald | 261 Creekside Dr. | 211+50 | Pool | 5 |
| Straehnke | 3895 Mumford Pl. | 211+50 | Concrete-lined pool, ornamental weaving along fence, pool pump & equipment along fence, solar heating pipes on fence, concrete patio between pool & fence | 3 |
| Cooke | 131 Green Meadow Way | 219+00 | Concrete-lined pool 8-ft patio between pool and channel, wood bench, circular sun deck | 4 |

the surrounding ground. The eighth pool (at the Liang residence) was constructed with a plastic liner backfilled with sand. According to the owner, the water is holding up the sides of the pool, which has never been drained. Construction vibrations may cause settlement or shifting of the sand backfill, thus distorting or damaging the plastic liner.

## UTILITIES

Several of the properties have underground utilities running along the back fence. Additionally, there are overhead utilities crossing the creek at virtually every residence. These overhead utilities are shown in the SCVWD preliminary engineering plans.

SF07/002E.50

## MITIGATION

General mitigative measures to help reduce the short- and long-term impacts are discussed in this section. These mitigative measures can be used either alone, or in combination, depending on the potentially impacted property.

### PRE- AND POST-CONSTRUCTION SURVEY

A survey of all potentially impacted structures should be performed before construction begins to assess the pre-construction condition of the structures. This survey should include photographing existing structures and documenting existing cracks or other damage. The same impacted structures should be surveyed after construction is complete. Information obtained from the post-construction survey should be compared to the pre-construction survey in order to evaluate the impacts, if any, on the existing structures. The surveys should be performed by a qualified civil engineer.

### MONITORING

Throughout the construction period, various monitoring devices should be installed and measured periodically. The monitoring devices can help detect ground movement or vibrations, so that remedial measures can be taken if settlement or vibrations become excessive. The exact location and frequency of measurement of the monitoring devices should be determined during final design of the project. The monitoring devices should include the following:

- Settlement monuments at various distances from the construction activity, and at strategic locations near potentially impacted structures.
- Boring cased with inclinometer casing near the excavation wall in the most critical areas to permit measurement of lateral ground deformation that may result from the proposed excavation and permanent wall.
- Vibration monitors installed on or near the potentially impacted structures to measure vibration intensity during pile driving and demolition.

After construction is complete, and the permanent channel wall is built, the settlement monuments and slope inclinometers should be measured periodically to help detect potential long-term movement of the channel wall and surrounding ground.

## PROTECT EXISTING STRUCTURES

Several remedial measures should be taken prior to construction to protect the existing structures. Strong tape should be put across the plate glass windows and sliding glass doors to help reinforce and protect the glass from excessive vibration. Swimming pools within the potential settlement zone should be drained prior to construction. Smaller structures, such as sheds, wood fences, and swimming pool pumps and equipment, should be removed and replaced after construction is complete. Underground and overhead utilities should be temporarily relocated during construction if they obstruct the construction operations.

The house foundations could be underpinned with grout prior to construction to strengthen the foundation subgrade and protect it from excessive settlement and lateral movement. This mitigative measure would be most effective for the houses closest to the channel, say within 5 to 10 feet. Several of the most critical houses could be underpinned prior to construction. Other potentially impacted structures would be carefully monitored. If excessive ground movement is detected, underpinning would then be done. The underpinning procedure consists of drilling holes on a grid adjacent to and below (with inclined borings) the foundation. Grout is injected under pressure and the foundation soil is displaced by grout with a resulting increase in density and strength. Grouting would cause some disruption of landscaping and patios that would need to be repaired. Care would need to be taken during underpinning to prevent the structure from rising as a result of excessive grout pressure.

## SHORING AND BRACING SYSTEM

The shoring and bracing should be designed and installed specifically to control ground movement. This would include an adequately stiff wall and sufficient bracing. Alternative bracing systems, such as a tied-back wall, should be considered. A tied-back wall would require an encroachment permit from the adjacent property owners. Monitoring of potential ground movement should be required throughout the construction period as described above. As was stated previously, the "permissible" amount of ground movement, i.e., the largest ground movement that could occur without damaging houses or other structures, is highly dependent on the type and condition of the structure, and the local soil conditions.

## REPAIR/REPLACE IMPACTED STRUCTURES

This mitigative measure involves allowing some damage to existing structures, and then repairing any damage that may occur. The pre-construction survey would be useful in identifying the level of effort required to repair or replace the structures. This alternative would lend itself primarily to smaller structures that would not be difficult or expensive to repair, or, in the worst case, replace outright. As an example, damaged radiant heating systems would most likely have to be replaced with an alternative source of heating, such as baseboard radiant heat. Similarly, swimming pools could be repaired or replaced. We anticipate that the plastic-lined pool will be need to be replaced.

SF07/002C.50

## REFERENCES

United Soil Engineering, Inc., "Geotechnical Investigation for Adobe Creek/Barron Creek Improvements, Palo Alto, California," prepared for Santa Clara Valley Water District, January 1988.

Wahler Associates, "Geotechnical Investigation, Proposed Adobe Creek Bridge, Middlefield and Charleston Roads, Palo Alto, California," prepared for Ruth and Going, Inc., February 1988.

CH2M HILL, INC., "Geotechnical Exploration, Santa Clara Valley Water District Creek Modification Project, Part II, Adobe Creek at Alma Street, Palo Alto, California," prepared for Santa Clara Valley Water District, July 1988.

Mana, A.I. and Clough, G.W., "Prediction of Movements of Braced Cuts in Clay," Journal of The Geotechnical Division, ASCE, Vol. 107, No. GT6, June 1981, pp 759-778.

Peck, R.B., "Deep Excavations and Tunneling in Soft Ground," Proceedings, 7th International Conference on Soil Mechanics and Foundation Engineering, State-of-the-Art-Volume, 1969, pp 225-290.

Clough, G.W., "Effects of Excavation Induced Movements in Clays on Adjacent Structures," Proceedings, 11th International Conference on Soil Mechanics and Foundation Engineering, 1985.

Greensfelder, R.W., "A Map of Maximum Expected Bedrock Acceleration from Earthquakes in California." California Division of Mines and Geology, 1973.

Seed, H.B. and Idriss, I.M., "Ground Motions and Soil Liquefaction During Earthquakes," Earthquake Engineering Research Institute, 1982.

Wiss, J.F., "Vibrations During Construction Operations," Journal of the Construction Division, ASCE, No. CO3, September 1974, pp 239-246.

SFO7/002D.50

# APPENDIX D

# NOISE AND AIR QUALITY ASSESSMENTS

Prepared by MO'C Physics Applied

# Adobe Creek

## Noise & Air Quality Assessments

September 1989

mo'c Physics Applied
1032 Elwell Court, room 244
Palo Alto, California 94303
(415) 968-5793

# *Contents*

## Acoustical Setting

**Interpretation of Noise Levels** 1
**Standards** 3

## Noise Impacts

**Construction Activities** 7

## Noise Mitigation Measures

**Barriers** 11
**Hours of Construction** 12
**Equipment** 12

## Air Quality Effects

**Attainment Status of the Basin** 15
**Air Pollution Phenomena** 16
**Project's Air Quality Effects** 17
**Air Quality Mitigation** 18

# Acoustical Setting

## Interpretation of Noise Levels

Noise intensity is customarily measured on a "decibel" scale which serves as an index of loudness. On this scale sounds as faint as 0 decibels are just barely audible, and only then in the absence of other louder sounds. Intense sounds of 120-140 decibels are so loud as to be painful or to cause damage to hearing with but a brief exposure.

These extremes are not encountered in commonplace environments. Outdoor noise levels along Adobe Creek are usually within the range of 40 to 60 decibels.[1]

*noise environment or event: (conditions) noise level*

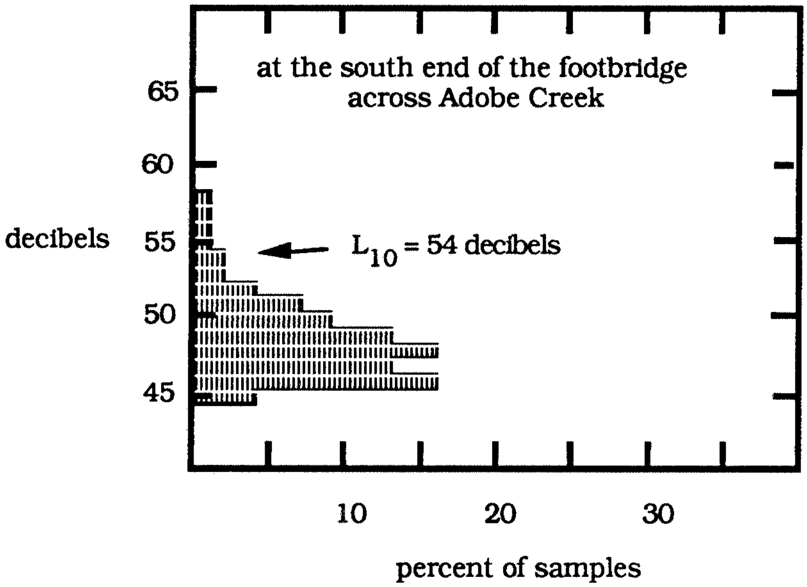
anechoic chamber: (hearing test) 0-20 decibels
recording studio: (background) 20 decibels
quiet woods: (in a rural area, still air) 30 decibels
residence: (indoors at night, quiet suburb) 35 decibels
office: (busy, open-plan) 55 decibels
normal conversation: (3 to 5-foot separation) 60-65 decibels
20 mph automobile: (25-foot separation) 65 decibels
50 mph dump truck: (50-foot separation) 90 decibels
train horn: (100-foot separation) 105 decibels
claw hammer: (on wooden plank) 120 decibels
shotgun: (at shooter's ear) 140 decibels

This report cites the City's comprehensive plan, which makes use of a certain kind of average noise level known as the $L_{10}$ exceedance level-- the decibel level which is exceeded over 10% of the hour, on 10 out of every 100 samples.

---

[1] All of the noise levels given in this report-- whether they are designated simply as "decibels" or not-- are the result of "A-weighting". A signal from a microphone which ordinarily varies in proportion to the instantaneous sound pressure level is conditioned by this weighting procedure to represent the apparent intensity or perceived loudness of the sound rather than its true physical intensity. Decibel levels are thus adjusted to take into account the fact that human hearing is less sensitive to very low or very high-pitched sounds than it is to sounds of less extreme frequencies of a few hundred to a few thousand cycles per second. The A-weighted decibel is abbreviated "dBA".

Environmental noise levels fluctuate as trucks or buses or platoons of automobiles pass on local streets or aircraft pass overhead, sometimes by more than twenty decibels over intervals as brief as a few seconds. The maximum noise levels within any interval of time are therefore significantly higher than the $L_{10}$ over the same interval; the minimum levels are often very much lower, as is shown on the figure below.

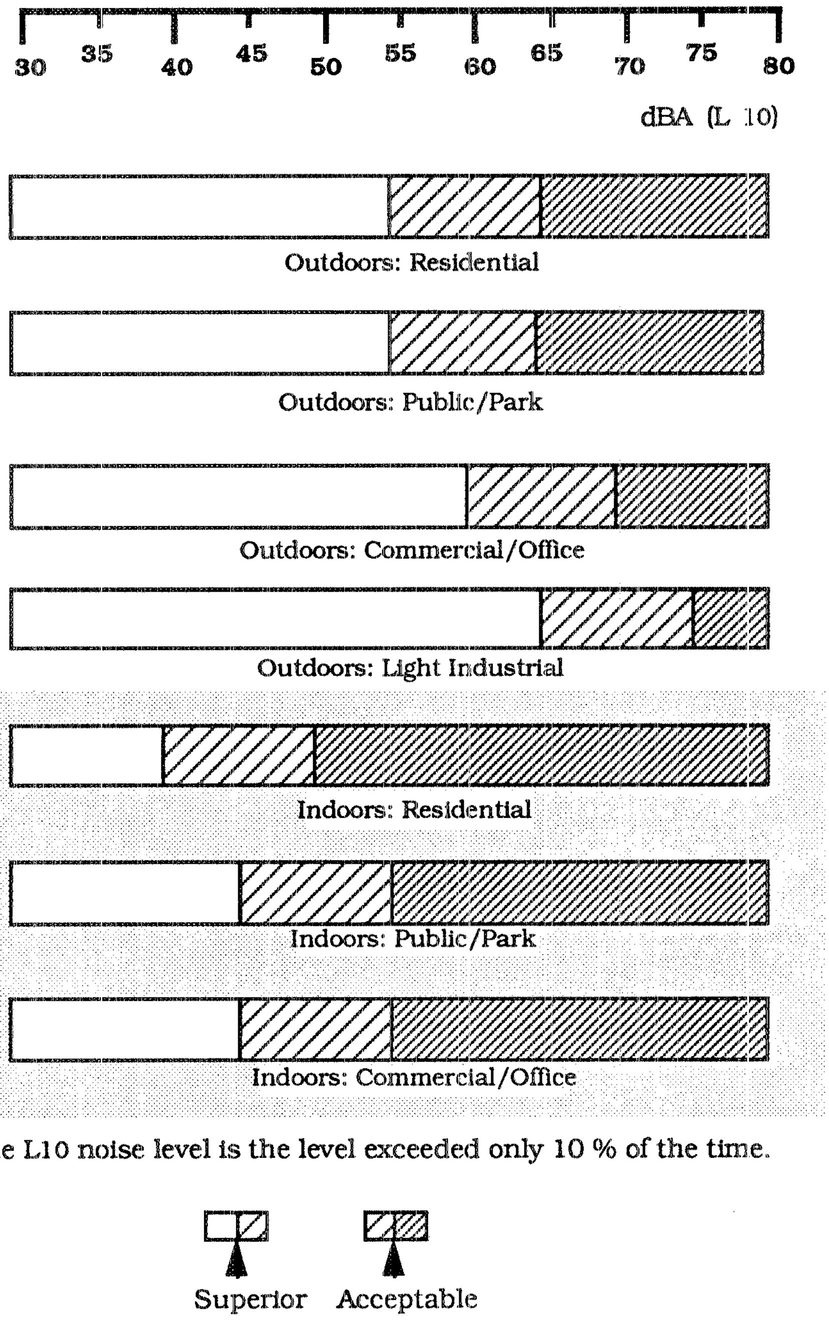


## Standards

### Comprehensive Plan

The City's comprehensive plan contains guidelines for determining the compatibility of the acoustic environments of lands with their uses. Residential and public/park land uses are rated as having the highest sensitivity to noise. (Commercial/office use is deemed to be less sensitive, and light industrial uses have the lowest sensitivity rating.)

Palo Alto Comprehensive Plan–
recommended daytime L10 noise levels



The L10 noise level is the level exceeded only 10 % of the time.

By comparing the noise level histogram on page 3 with the chart on the facing page it is easily seen that the back yard acoustical environments along the Creek are to be rated "superior" according to the City's comprehensive plan standards.[2]

## The City's Noise Ordinance

Noise ordinances are criminal statutes. The City's noise ordinance was revised (in 1987) after a Palo Alto police officer cited an operator of construction equipment which was being used on a municipal public works project.

The new ordinance is less stringent in application to construction equipment than to other equipment, such as "residential power equipment". It provides that "no individual piece of (construction) equipment shall produce a noise level exceeding 110 dBA at a distance of 25 feet" and that "the (total construction) noise level at any point outside of the property plane of the project shall not exceed 110 dBA", except that the latter provision is inapplicable to construction equipment which is operated by "city employees, city contractors, or public utility companies or their contractors".[3]

The ordinance limits hours of construction to 8:00 am to 8:00 pm on weekdays, 9:00 am to 8:00 pm on Saturdays and 10:00 am to 6:00 pm on Sundays and holidays.

---

[2] Of course the residences along Alma Street and Charleston Road (at the limit points of the project) are affected by roadway noise and do not enjoy such a good environment, but the noise levels of the histogram on page 3 are typical of the environments of the majority of the residences along the Creek within the section which is to be improved. The City's comprehensive plan noise standards are not intended to govern construction noise. Nonetheless, they represent policy goals and provide a frame of reference for the assessment of noise impacts.

[3] See Chapter 9.10, § 9.10.060 (d). The wording of sub-part (d) is apparently ambiguous. This is the consultant's interpretation.

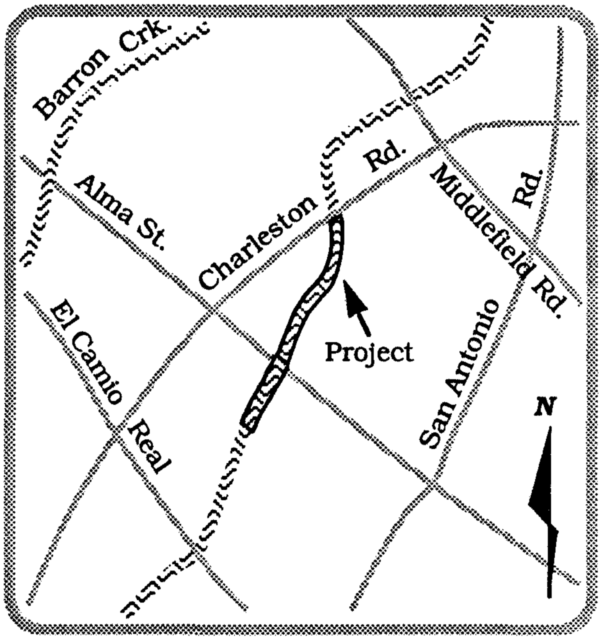
Exceptions to any of the provisions of the ordinance are allowed if "diligent investigation of available noise abatement techniques indicates that immediate compliance... would be impractical or unreasonable", in which cases permits can be issued "with appropriate conditions to minimize the public detriment".

Such permits are issued on the authority of the city manager. There is no provision for a public hearing or for notice to the public, but aggrieved persons may appeal to the city council.[4]

---

[4] See § 9.10.070 of the ordinance.

# Noise Impacts



## Construction Activities

The project would consist of reconstruction of the concrete creek bed, replacing the existing trapezoidal prism bed with a "U" channel. The walls of the new channel would extend several feet above the surface of the adjacent ground, so as to form a flood wall.

The construction would take as much as two construction seasons (April to October). The activities could consist of:

- removal of trees and other structures in adjacent backyards
- removal of backyard fences
- installation of construction fences
- drilling for soldier piles
- jackhammering & removal of existing concrete channel walls & invert
- excavation for shoring system & installation of lag boards
- loading & removal of concrete wall & invert
- pouring of channel bottom
- construction of forms for new channel walls
- pouring of concrete for new channel walls
- removal of forms
- backfilling behind new walls
- construction of new backyard fences
- removal of the footbridge
- construction of a new footbridge
- diversion of Adobe Creek flow with a pump

Diesel-powered heavy equipment, jack hammers and gasoline-powered chain saws would be used on the project. Peak noise levels from individual pieces of such equipment would often fall in the 90 to 100 decibel range at a distance of 25 feet.[5]

Noise levels change by 6 decibels for every factor of two change in distance separation from a localized source.[6] Thus a tool which gives off 95 decibels at 25 feet registers about 101 decibels at 12.5 feet and about 107 decibels at 6 feet.

---

[5] For examples of construction noise levels see: Handbook of Noise Assessment, publ. Van Norstrad Reinhold, ed. Daryl N. May, 1978.

[6] i. e., from a source which is not extended and is in effect like a point in space rather than an area or a volume

The significance of this numerical progression lies in the fact that some of the work would take place along the property line, within a few feet of the residents. To state the obvious, some of the construction noise from the the project would be *very* loud and annoying.[7]

*Illustrative Noise Levels from Construction Equipment*

| equipment | noise levels at 25 feet *(decibels)* |
|---|---|
| backhoes | 78-99 |
| loaders | 78-90 |
| dump trucks | 89-100 |
| cement trucks | 89-100 |
| cranes | 82-93 |
| chain saws | 90-100 |
| pavement breakers | 82-92 |
| jack hammer | 88-103 |

It is also possible that pile drivers could be used, which could produce peak impact noise levels of 100-110 decibels. A pump may be used to divert creek water around the construction. The pump would operate 24 hours per day.

Of all the residences along the Creek, the worse-affected would be those at the access point for construction equipment. Of course, the likely access points are at Alma Street and at Charleston Road. The heavy equipment such as the cranes, the dump trucks and the cement trucks would be temporarily stationed near these residences to be loaded or unloaded.

---

[7] It would be loud and annoying whether or not there would be violations of the City's noise ordinance.

Smaller pieces of mobile equipment such as backhoes, loaders, dozers and pickup trucks would travel to and fro along the creek bed carrying building materials and rubble to and from the work site.

The effect of the construction would be significant temporary increases in time-averaged and peak noise levels, particularly at the residences on the Creek nearest to the access points for the construction equipment.

The construction noise levels within creekside homes would be high enough to cause significant levels of speech interference and sleep disturbance, even with the windows closed.[8]

---

[8] There would be no nighttime construction, but not everyone sleeps only at night. The pump which may be used to divert water around the construction site would run all night and might prove annoying to some even if it were well-muffled.

# Noise Mitigation Measures

## Barriers

Since the most-affected residences would be those near the access points for the construction equipment, it would be feasible to provide temporary plywood walls to shield those residences from some of the noise generated by heavy diesel road equipment such as dump trucks, cranes and cement trucks.

This approach would be most feasible and effective at the residence on Alma Street on the east side of the Creek and at the residences on Charleston Road on both sides of the Creek. (The other residence on Alma Street on the west side of the Creek is well set back from the Street and so would not be as affected by noise from the trucks and other heavy road equipment.)

Along the creek bank the walls should extend to a height which exceeds that of the eaves of the roofs. Where it appears feasible and effective to continue the wall around the corner of the lot, along the roadway property line, the wall there should be about 12 feet high–higher than most diesel exhaust stacks.[9] The plywood should be at least a half inch thick and the surface should be continuous.[10]

## Hours of Construction

The hours of construction which are specified by the City's noise ordinance should be observed.

## Equipment

Gasoline-powered chain saws and jackhammers are among the noisiest of the pieces of equipment which might be used on the project. It would be preferable to use pavement breakers wherever practical, in lieu of jackhammers.

---

[9] There is a garage in the corner of one of the affected properties. It would be acoustically ineffective and unnecessary and otherwise impractical to block the driveway there with a wall.

[10] Unlike interior panels, outdoor walls do not need to have sealed joints.

It also would also be preferable to use hand saws instead of gasoline-powered chain saws.[11] Pumps used to divert water around the construction work should be well-housed to reduce noise emissions.[12]

---

[11] Electrically-powered saws could also be used since generators are hardly as noisy as gasoline-powered saws and since generators could be positioned further away from the residences than the saws.

[12] The creek diversion pump equipment which would run at night should be electrically powered (by the City's power lines) and should have an airtight enclosure with an absorptive lining.

# Air Quality Effects

### Attainment Status of the Basin

The Federal clean air act deadline was extended by the 100th Congress to August 31st of 1988. By that date clean air standards had not been attained in the San Francisco Bay area, which still has exceedances of Federal standards for ozone and carbon monoxide.

## Air Pollution Phenomena

### Ozone

Episodes of high ozone concentrations occur during summer months on warm sunny days in which there is a strong "temperature inversion" aloft which caps the height to which surface-released contaminants can be dispersed.

Ozone is a gas which is not directly emitted as a component of flue gas or engine exhaust. It is instead a product of a complex set of chemical reactions between oxides of nitrogen and certain organic (hydrocarbon) compounds– precursors which *are* in flue gas and engine exhaust. The photochemical reactions which produce ozone do not occur instantaneously. It takes more than an hour from the time of emission of the precursors for significant concentrations of ozone to develop. Because of this delay ozone is not particularly evident near roadways or industrial plants where precursor compounds are emitted.

Thus the ozone concentrations in Palo Alto are principally imported from San Mateo County, and emissions of ozone precursors from Palo Alto affect communities to the south.

Concentrations of ozone exceed the Federal standard of 0.12 parts per million (averaged over one hour) once or twice every year or two at the Bay Area Air Quality Management District monitoring station in Redwood City.

Carbon Monoxide

The phenomenon of carbon monoxide episodes is quite different. This pollutant is principally emitted directly as a component of vehicular tailpipe effluence. The season for carbon monoxide is winter; peak hourly concentrations are found during the traffic commute periods and, sometimes, in late evening.

Exceedances of the Federal standard of 9.0 ppm (averaged over 8-hours) do occur in Palo Alto every winter or two.[13]

Particulates

The State's new particulate standard pertains only to particles which have a diameter of less than 50 millionths of a meter. The standard is exceeded if concentrations of such particles exceed 50 micrograms per cubic meter of air over any 24-hour period. Exceedances occur frequently throughout much of the State. Exceedances are found to occur once every few days on the Peninsula and in the south Bay area.

Small particles are among the products of combustion processes, but resuspension of roadway dust accounts for most airborne particulate matter.

## Project's Air Quality Effects

Carbon Monoxide

The project would not affect episodal carbon monoxide concentrations because there would be very little work done in winter, the season for carbon monoxide.

---

[13] The City commissioned a field study of carbon monoxide which took place in the winter of 1985-86. Two exceedances of the Federal standard were found in a three month period.

Ozone

The project would not cause local concentrations of ozone to be increased because ozone is not a component of engine exhaust. Emissions of ozone precursors from construction equipment would contribute to the development of ozone concentrations downwind, but their effect would be undetectable.

This is easily seen by noting that the pieces of construction equipment in use along the creek bed would number about as many as vehicles on a busy street, and a rather short section of street at that. The emissions would clearly be minuscule in comparison with all the emissions from Palo Alto.

Particulates

The concrete creek bed would be almost completely dry during the construction. Dust would be raised by the vehicles traveling up and down the creek bed to and from the work site. Some of the other equipment could cause some dust to be raised (e. g., pavement breakers).

## Air Quality Mitigation

Dust could be mitigated by sweeping or washing the concrete creek bed as needed.

# APPENDIX E

# ALTERNATIVES ANALYSIS/ SUPPLEMENT TO ALTERNATIVES ANALYSIS

Prepared by Santa Clara Valley Water District

**SANTA CLARA VALLEY WATER DISTRICT**

# ADOBE CREEK PHASE IV
# FLOOD CONTROL ALTERNATIVE ANALYSIS
# ALMA STREET TO EL CAMINO REAL

prepared by

David E. Hook, P.E.
Associate Civil Engineer
with
Kurt Flammer
Assistant Civil Engineer

under the direction of

James M. Fiedler, P.E.
Senior Engineer, Design Division

John T. O'Halloran
General Manager

Robert R. Smith
Flood Control Manager

June 21, 1989

# TABLE OF CONTENTS

Page
Preface....................................................1
Summary....................................................2
Project Alternatives
1. 20 Foot to 17 Foot Wide U-frame Channel (preferred alternative)........................4
2. No Project.................................13
3. Floodwalls with 17-Foot U-frame Channel......14
4. Adobe Creek Bypass...........................17
5. Upstream Storage.............................24
6. Diversion....................................39

BIBLIOGRAPHY...........................................54

APPENDICES

1. Cost Estimate for Preferred Alternative (17'/20' U-frame Channel)
2. Freeboard
3. Hydrographs

FIGURES

1-4. 20'/17' Foot U-frame Channel - Cross-sections..........................5-8
5. 20'/17' U-frame Channel - Water Surface Profile....................9
6&7. Floodwalls with 17' U-frame Channel - Cross-sections...........................15
8. Adobe Creek Bypass Alignment...............18
9&10. Bypass Box Culvert - Cross-sections........20-21
11. Hidden Villa Dam Site......................25
12. Not Included
13. Foothill College Dam Site..................29
14. Terman Jr. High School and Alta Mesa Cemetery Dam Sites.........................33
15. Adobe Creek Diversion Alignment............40
16. Matadero Creek (PAFB to Ross Road) - Cross-Section............................43

TABLES

1. Comparative Summary of Project Alternatives.....3
2. Channel Wall Heights - 20'/17' U-Frame Channel.10-11

# Preface

Homeowners adjacent to Adobe Creek between Alma Street and Charleston Road have questioned the choice of flood control measures in this reach of channel. They have asked the District to present the alternatives for flood control in this reach of Adobe Creek.

This report presents these alternatives.

## SUMMARY

This report contains a description of the flood control alternatives for Adobe Creek between Charleston Road and Alma Street.

The preferred alternative is the 20 foot/17 foot U-frame channel, which requires complete replacement of the channel in this reach.

The other alternatives considered are: no project; floodwalls/17 foot U-frame; a bypass; upstream storage; and diversion of excess flow to Matadero Creek.

The preferred alternative has been chosen due to moderate wall heights and visual impacts, moderate cost, minimal long term environmental impacts, stable hydraulics, and lack of negative impacts on local drainage.

See Table 1 for a summary of the factors affecting the choice of the 20 foot/17 foot U-frame channel as the preferred alternative.

# ADOBE CREEK PHASE IV
# COMPARATIVE SUMMARY OF PROJECT ALTERNATIVES

**TABLE 1**

| ISSUES & CONCERNS | *Preferred Alternative*<br>17'/20' U-FRAME | NO PROJECT | FLOODWALLS/ 17' U-FRAME | BYPASS | UPSTREAM STORAGE | DIVERSION |
|---|---|---|---|---|---|---|
| (1) PROJECT COST | $5.8 million | $3 1 million/year, or $30 million in 1% flood | $4 million | $12 million | $30 - $40 million | $49 million |
| (2) PHYSICAL ENVIRONMENT | | | | | | |
| (A) GENERAL DESCRIPTION | Replace channel between Charleston & 800' u/s of SPTC. Replace SPTC culvert & modify Alma Culvert. | Flooding will continue | Install floodwalls for 1600' u/s of Charleston; Replace rest of Channel and culverts per 17'/20' U-frame. | Install RCB along Alma to Charleston, and along Charleston to Adobe Creek. | Store portion or all of excess channel flow in Reservoirs upstream. | Divert excess flow to Matadero Creek, & upsize Matadero Creek. |
| (B) LOCAL DRAINAGE | No significant change. in local storm drainage | No change in local storm drainage. | Severely impacted due to water surface well above ground. | No change in local storm drainage. | No change in local storm drainage. | No change in local storm drainage. |
| (C) ROADS & BRIDGES | See above. | None | See above | Extreme construction impact on Charleston Road. Replace Charleston Road bridge. | Depends upon reservoir site. | Replace most bridges on Matadero Creek, per 1988 Engineer's Report. |
| (D) UTILITIES | Minor impacts. | None | Minor Impacts. | Major utility relocation crossing Alma & on Charleston Road. | Depends upon reservoir site. | Significant impacts. |
| (E) TRAFFIC | Minor impacts. | None | Minor Impacts. | Significant traffic impacts. | Significant traffic impacts. | Significant traffic impacts. |
| (F) RIGHT OF WAY | No additional r/w needed. | No additional r/w needed. | No additional r/w needed. | Additional r/w needed along SPTC and two other locations. | 20 to 70 acres needed. | Additional r/w needed from Alta Mesa Cemetary. |
| (G) OTHER | Significant construction impacts along creek. 5 ft maximum wall height. | Flooding will continue. | 9' max. floodwalls, significant construction impacts along creek. | Significant construction impacts along bypass. | Significant construction and long term impacts. | Significant construction and long term impacts. |

## 20 FOOT/17 FOOT WIDE U-FRAME CHANNEL ALTERNATIVE
## (The Preferred Alternative)

### Background

This alternative consists of the removal and replacement of the existing trapezoidal concrete channel with a U-frame concrete channel, from Charleston Road to 800 foot upstream of Alma Street (within the available right of way between the existing fences). The Alma Street bridge would be modified and the SPTC culvert replaced.

The chief aims of this alternative are to: (1) provide a stable water surface profile that would not impact local drainage; (2) keep channel walls below existing fence heights; and (3) keep the channel between existing backyard fences and not utilize the full width of the District's right of way for flood control purposes.

### Design Flow

The design flow in Adobe Creek between Alma Street and Charleston Road is 3100 cfs (Adobe Creek Hydrology Report, Bibliography, Ref. #1).

### Configuration

The existing trapezoidal concrete channel lining would be removed and shoring installed to support the excavation for the U-frame channel. A 20 foot wide concrete U-frame channel would be installed from Charleston Road to 1500 feet upstream. The channel would transition into a 17 foot wide U-frame channel for another 1600 feet. See Figures 1 and 2 for cross-sections. This would allow the enlargement of backyards adjacent to the 17 foot U-frame channel after construction.

The Alma Street culvert would be modified, and the Southern Pacific Transportation Company (SPTC) culvert would be replaced (see Figures 3 and 4). This would avoid significant traffic impacts due to the replacement of the Alma Street bridge.

### Water Surface Profile

See Figure 5 for a water surface profile. The maximum wall height is 5 foot. See Table 2 for wall heights along the channel, by station and property owner.

A lower water surface, with lower wall heights, could have been obtained through the use a wider trapezoidal channel cross section. However, these measures would have required the permanent use of the District's 30 foot right of way between Alma Street and Charleston Road.

# Adobe Creek Phase IV
## Preferred Alternative
## Wall Heights

## TABLE 2

06/16/89

| STATION (FEET) | CHANNEL LENGTH (FEET) | WEST BANK RESIDENTS | EAST BANK RESIDENTS | WALL HEIGHTS ABOVE EXISTING TOP OF BANK (IN FEET) 17 & 20 FT U-FRAME CH. |
|---|---|---|---|---|
| 196+86 | | BEGIN PROJECT UPSTREAM | | 1.8 |
| | 31 | OF CHARLESTON ROAD | | |
| 197+17 | | | | 1.7 |
| | | AHRENS | DOWNS | |
| | 288 | KIRKEBY | JUSTICE | |
| | | LIANG | BECKER | |
| | | | GOLDEN | |
| 200+05 | | | | 2.6 |
| | | LIANG | GOLDEN | |
| | 152 | LOBATO | KADIS | |
| | | LUBOW | DESSAIN | |
| | | | WHEELER | |
| 201+57 | | | | 3.4 |
| | 51 | LUBOW | WHEELER | |
| | | SCHNITZER | HELLER | |
| 202+08 | | | | 4.0 |
| | | SCHNITZER | HELLER | |
| | | DAU | THOMPSON | |
| | 257 | COLLINS | LINDHOLM | |
| | | JOHNSON | WANG | |
| | | FUNG | | |
| 204+65 | | | | 3.6 |
| | | FUNG | WANG | |
| | 57 | | BOEHRS | |
| 205+22 | | | | 3.8 |
| | | FUNG | BOEHRS | |
| | 63 | PUTNUM | MORRIS | |
| 205+85 | | | | 3.7 |
| | 33 | PUTNUM | MORRIS | |
| 206+18 | | | | 3.4 |
| | | PUTNUM | MORRIS | |
| | 207 | PRESTON | OLMSTEAD | |
| | | KYLE | BARNES | |
| | | | PORTER | |
| 208+25 | | EXISTING FOOTBRIDGE CROSSING | | 2.2 |
| | | MORRISON | FAY | |
| | 109 | | WALL | |
| 209+34 | | | | 1.8 |
| | | CITY OF | WALL | |
| | 39 | PALO ALTO | HAINES | |
| | | GRANDBURG | | |
| 209+73 | | | | 1.9 |
| | | GRANDBURG | HAINES | |
| | 121 | TINCHER | VAN DE RIET | |
| 210+94 | | | | 4.9 |

| STATION (FEET) | CHANNEL LENGTH (FEET) | WEST BANK RESIDENTS | EAST BANK RESIDENTS | WALL HEIGHTS ABOVE EXISTING TOP OF BANK (IN FEET) 17 & 20 FT U-FRAME CH. |
|---|---|---|---|---|
| 210+94 | | | | 4.9 |
| | 16 | TINCHER | BERWALD | |
| 211+10 | | | | 4.8 |
| | | TINCHER | BERWALD | |
| | 10 | STAEHNKE | | |
| 211+20 | | | | 4.8 |
| | | STAEHNKE | BERWALD | |
| | 54 | | BRANN | |
| 211+74 | | | | 4.5 |
| | 36 | STAEHNKE | BRANN | |
| 212+10 | | | | 4.4 |
| | 32 | STAEHNKE | BRANN | |
| 212+42 | | | | 3.4 |
| | | BERG | PALMER | |
| | 109 | SCHMITZ | WAGNER | |
| 213+51 | | | | 3.4 |
| | | SCHMITZ | WAGNER | |
| | 58 | | SHAPERO | |
| 214+09 | | | | 3.8 |
| | | SCHMITZ | SHAPERO | |
| | 201 | HART | OKNER | |
| | | GLAUZ | GILBARG | |
| | | NORBERG | TILTON | |
| 216+10 | | | | 2.3 |
| | | NORBERG | TILTON | |
| | 96 | ELSPAS | TAO | |
| 217+06 | | | | 3.2 |
| | | ELSPAS | TAO | |
| | 102 | DRAPKIN | TRACT 4927 | |
| 218+08 | | | | 2.9 |
| | 172 | DRAPKIN | TRACT 4927 | |
| 219+80 | | DOWNSTREAM FACE OF ALMA STREET | | 1.6 |

| | | | |
|---|---|---|---|
| TOTAL CHANNEL LENGTH | 2294 | WEIGHTED AVERAGE WALL HEIGHT | 3.0 |
| | | MAXIMUM WALL HEIGHT | 4.9 |

# ADOBE CREEK, PHASE IV
# U-FRAME CHANNEL

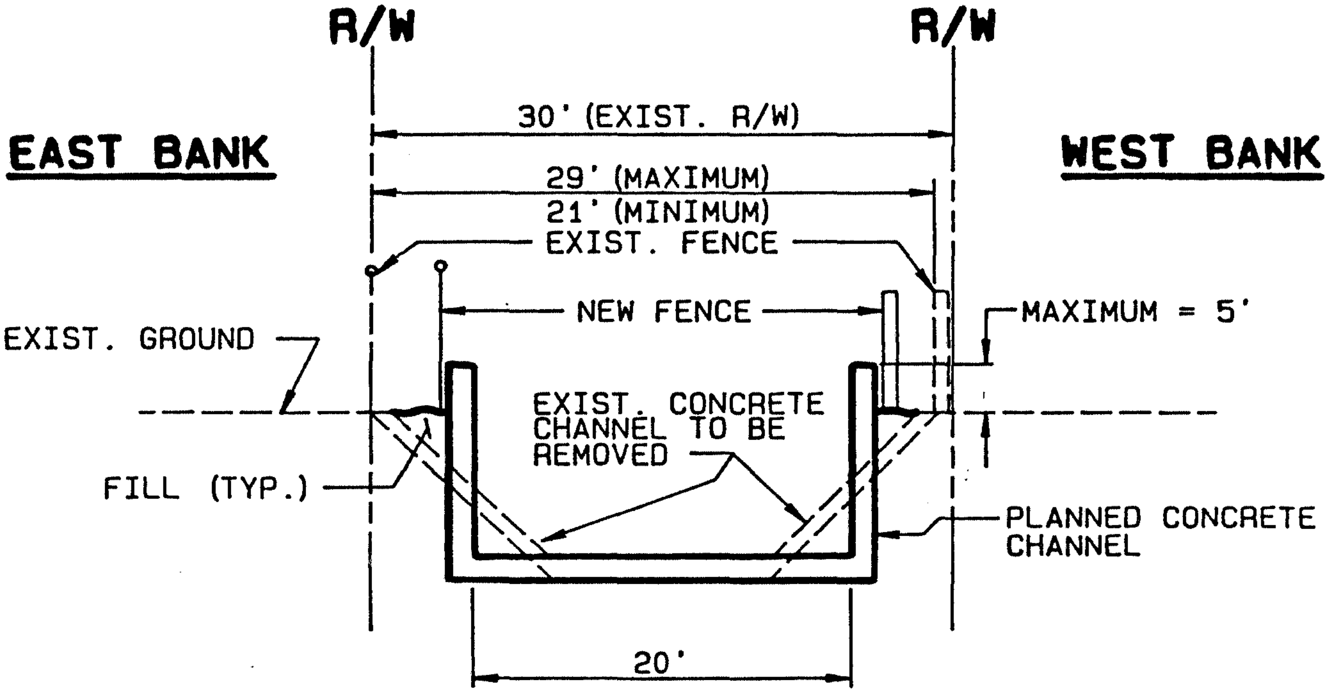


**FIGURE 1**

**STA.196+86 TO STA.210+65**

**U-FRAME CHANNEL SECTION**

# ADOBE CREEK, PHASE IV
# U-FRAME CHANNEL

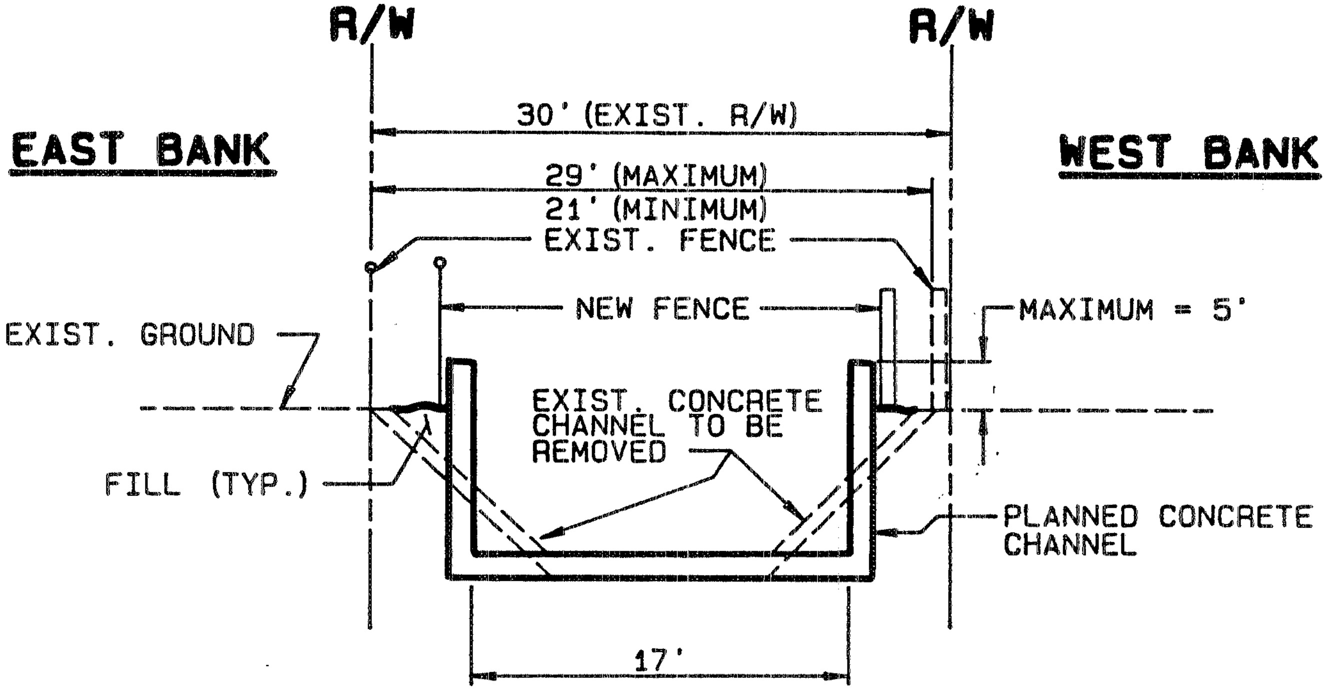
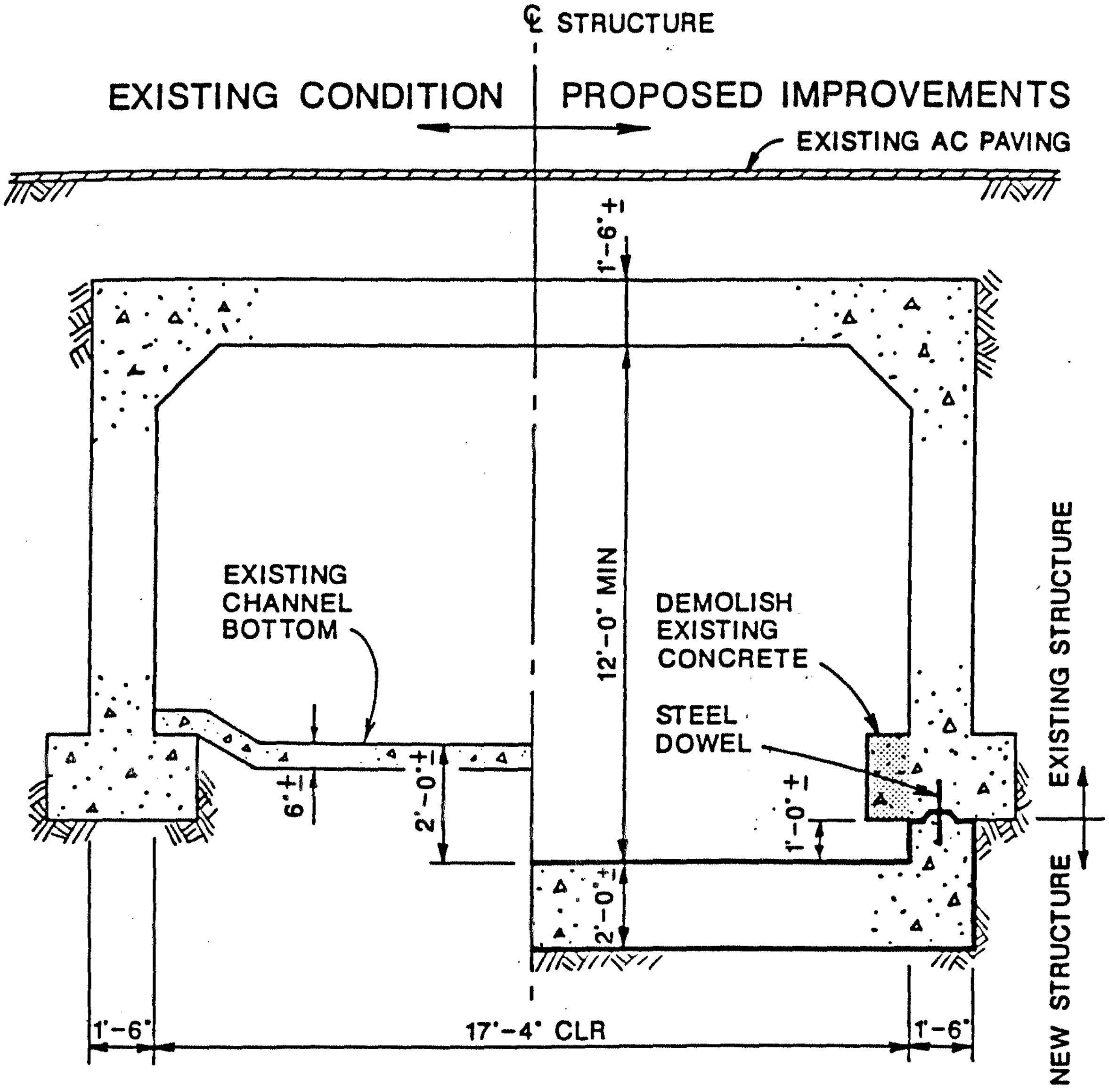


FIGURE 2

STA.210+85 TO STA.219+85

U-FRAME CHANNEL SECTION

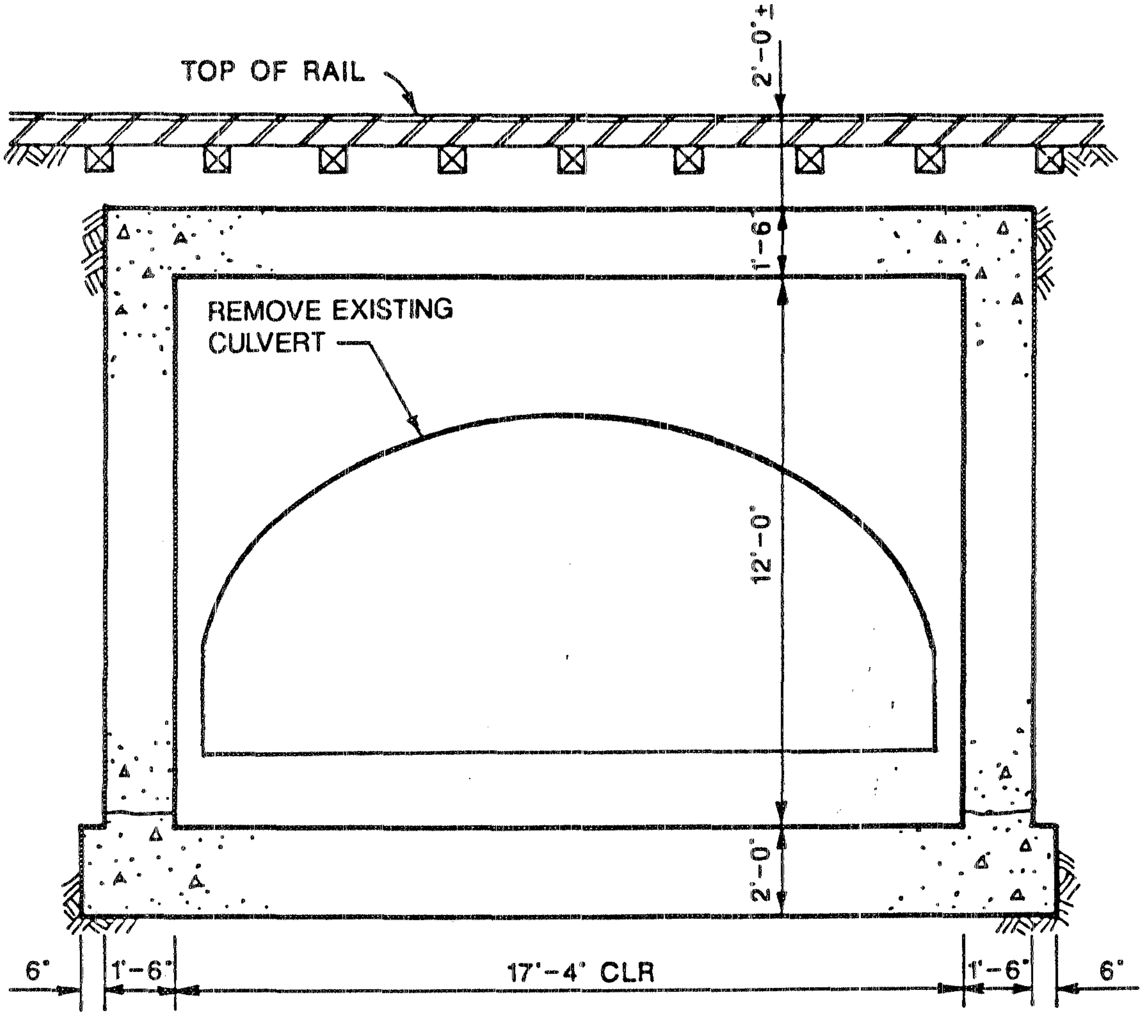


SECTION

BRIDGE MODIFICATION AT ALMA STREET

NTS

FIGURE 3



SECTION

BRIDGE AT RAILROAD CROSSING

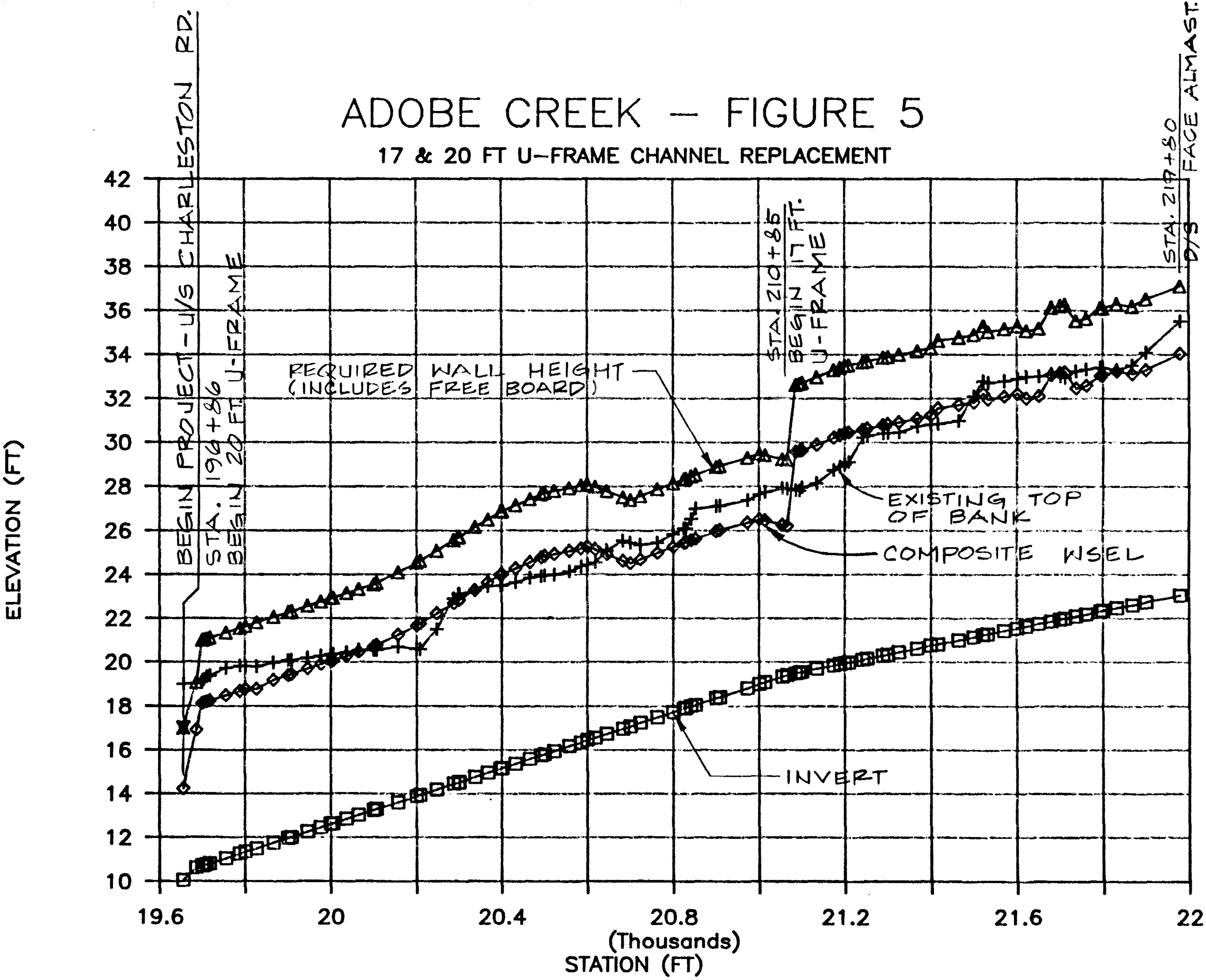
NTS

FIGURE 4

CH2M HILL

# ADOBE CREEK – FIGURE 5

## 17 & 20 FT U-FRAME CHANNEL REPLACEMENT



## Impacts

### Construction Impacts

Noise, dust, and air pollution along the creek.

Construction vehicle access into Adobe Creek from Alma Street and Charleston Road (to work on the channel removal and replacement, and culvert modification and replacement), would impact traffic on Alma Street and Charleston Road.

Temporary removal and replacement of existing backyard fences along the channel between Alma Street and Charleston Road would be necessary for channel installation. Backyard vegetation would also be affected.

The footbridge between Duncan Place and Creekside Way would be out of service for several months during channel construction.

Installation of U-frame channel might cause damage to neighboring structures, including floor slab heating systems.

Vibrations due to pile driving, if used for shoring, could damage structures, including floor slab heating systems.

### Long Term Impacts

U-frame channel walls 5 foot or less above ground between Charleston Road and 800 feet upstream of the SPTC culvert would have a visual impact on the neighborhood.

In order to preserve privacy in the neighboring yards, the fences next to the footbridge would have to be extended.

### Cost

Costs for this alternative would include channel removal and replacement with a U-frame channel, replacement of the SPTC culvert, and modification of the Alma Street culvert, along with repair of any structural damage caused by construction.
The total cost of this alternative is $5,800,000 (see Appendix 1).

### Conclusion

The cost and construction impacts are greater than those of the floodwall/17 foot U-frame alternative. However, the advantages of moderate wall heights and visual impacts, moderate cost, minimal long term environmental impacts, stable hydraulics, and good local drainage combine to make this the preferred alternative.

## NO PROJECT ALTERNATIVE

Under this alternative, the District would construct no further flood control measures to reduce the existing flood hazard from Adobe Creek between Charleston Road and El Camino Real.

### Disadvantages

The areas upstream and downstream of the SPTC culvert would continue to be subject to flooding due to the SPTC culvert.

Residents and businesses would continue to face potential hardships due to flooding.

Flooding due to the SPTC culvert could occur on an average of once every three years. While the depth of flooding downstream of the SPTC culvert would decrease in some areas due to improvements in the culverts and channel, the extent of flooding would be largely unchanged. More than 1300 homes and apartments and 57 commercial and industrial buildings would be inundated, to depths of up to two feet.

One percent (1%) flood damages were calculated to be as high as $21 million in 1984. While the amount of damages would be reduced slightly due to the already completed channel and culvert improvements on Adobe Creek, flooding in the areas of major damage would not change. Today, the 1% flood damages would be $30 million.

Flood insurance would continue to be required for some property owners in the flood hazard zone as defined by FEMA.

### Advantages

Advantages include:

No construction impacts.

No change in local drainage.

No construction costs.

No long term impacts, except flooding.

### Conclusion

This alternative has no construction costs or impacts. However, it does not solve the flooding problems due to Adobe Creek at the SPTC culvert. This is not a feasible alternative.

# FLOODWALLS WITH 17 FOOT U-FRAME ALTERNATIVE

## Background

This alternative is a variation on that proposed in the 1985 Adobe Creek Engineer's Report (Bibliography, Ref. #3) for the reach of channel between Alma Street and Charleston Road. It is an attempt to leave the existing concrete channel intact to the greatest extent possible, while safely conveying the design flow of 3100 cfs. A secondary goal is to avoid the removal and replacement of the Alma Street bridge if possible.

## Configuration

The existing channel between Alma Street and Charleston Road is a non-prismatic trapezoidal concrete channel with several abrupt drops in the channel bottom.

In order to leave a portion of the existing channel intact with minimal modifications, the lower section will have floodwalls installed at the top of the banks, and the drops filled in (see Figure 6). This channel configuration would extend 1500 feet upstream of Charleston Road.

The next 1600 feet of channel would consist of replacing the existing trapezoidal channel with a 17 foot U-frame channel (see Figure 7). This would allow the enlargement of adjacent backyards after construction.

The Southern Pacific Transportation Company (SPTC) culvert would be replaced, and the Alma Street culvert modified (see Figures 3 and 4). This would avoid significant traffic impacts due to the replacement of the Alma Street bridge.

## Wall Height

The maximum wall height is 9.2'.

## Impacts

## Construction Impacts

Noise, dust, and air pollution along the creek.

Construction vehicle access into Adobe Creek from Alma Street and Charleston Road (to work on the channel modification and replacement, and the culvert modification and replacement), would impact traffic on Alma Street and Charleston Road.

Temporary removal and replacement of existing backyard fences along the channel between Alma Street and Charleston Road would be necessary for floodwall and channel installation. Backyard vegetation would also be affected.

existing borings, it does not appear that there are soil deposits at the site that are susceptible to this type of densification. However, there may be loose lenses or layers of sand that were not encountered during drilling. Also, any man-made sandy fill, such as utility line or swimming pool wall backfill may be susceptible to vibration densification.

The pile driving vibrations may cause direct architectural or structural damage to surrounding structures, and may be a nuisance to residents. There are several correlations between the vibration intensity (as measured by particle velocity) and various threshold limits. According to Wiss (1974), the vibrations become "unpleasant" to humans at about 0.2 inch/second (in./sec), and "objectionable" at about 0.6 in./sec. From an architectural standpoint, the recommended safe vibrational level for residences is 2 in./sec. Residential plaster cracks at about 5 in./sec.

The vibration intensity caused by pile driving depends on the type of pile driving equipment and on the soil conditions at the site. Driving sheet piles with a vibratory pile driver at the project site could induce ground vibrations on the order of 5 in./sec. at about 5 feet from the pile (Wiss, 1974). The vibration intensity will decrease with distance from the pile. Therefore, buildings and other structures within 10 feet of the pile driving operation may be subject to damaging vibrations. Within about 100 feet of the pile driving, people may find the vibrations objectionable.

## DEMOLITION

We anticipate that demolition of the existing concrete channel will be done with a backhoe-mounted jackhammer or other heavy equipment. The demolition will most likely cause dust, noise, and vibration to the surrounding areas. The vibration levels caused by the demolition are difficult to predict, but could be on the order of 0.5 in./sec at about 5 feet from the demolition (Wiss, 1974).

## DEWATERING

Depending on the actual groundwater level encountered during construction, excavation dewatering may or may not be required. We anticipate that the groundwater level is near the base of the existing channel, and that some dewatering will be required. According to SCVWD personnel, dewatering was required at the Charleston Road bridge construction. Settlement monuments placed about 5 feet from the construction area showed settlement of about 1/2 inch within 2 or 3 months as a result of the dewatering.

# LONG-TERM IMPACTS

## SEISMIC HAZARDS

Because the project area is near active faults, it is reasonable to assume that the project area will be subjected to strong ground shaking from at least one moderate to severe earthquake during the life of the project. Table 2 lists the distance to the major faults from the project area, along with magnitude estimates for the maximum credible earthquake and peak horizontal ground accelerations at the site.

Table 2
ACTIVE FAULTS
PROPOSED ADOBE CREEK IMPROVEMENTS
Palo Alto, California

| Fault | Distance From Site (miles) | Est. Earthquake Richter Magnitude[a] | Est. Ground Acceleration At Site[b] |
|---|---|---|---|
| San Andreas | 8 Southwest | 8.25 | 0.45 g |
| Hayward | 10.6 Northeast | 7.5 | 0.37 g |
| Calaveras | 15.67 Northeast | 7.5 | 0.30 g |

---

[a] From Greensfelder, 1973

[b] Based on correlations by Seed and Idriss, 1982

The fault zone of primary concern to this project is the San Andreas. It should be noted that the project area is subject to the same seismic risk regardless of whether the creek improvements are made or not.

No loose saturated clean sand was noted in any of the existing boring logs at the site. Therefore, liquefaction of the subsurface material beneath the proposed channel improvements is unlikely due to the generally fine-grained, cohesive nature of the subsurface soil.

## SETTLEMENT

As with the temporary shoring and bracing system, ground movement could occur if the permanent channel wall rotated inward toward the channel. If the backfill behind the channel wall was improperly compacted, settlement could occur over the long term.

## POTENTIALLY IMPACTED PROPERTIES AND STRUCTURES

It is not within the scope of this work to predict exactly how each potentially impacted structure will respond to the proposed construction. In this section, potentially impacted structures will be listed and briefly discussed. Only important structures will be addressed; lesser structures, such as fences or trees, will not be discussed. The information presented in this section is based on the project aerial photographs and our field reconnaissance. The potentially impacted houses are listed in Table 3, along with distance to the channel top-of-bank and any significant features. Other potentially impacted structures such as pools, sheds, and patios are listed in Table 4.

### HOUSES

There are 24 houses within the potential zone of settlement (20 feet from the channel top-of-bank). As can be seen in Table 3, several houses are close to the proposed construction. Several houses have overhanging eaves adjacent to the channel that could obstruct the proposed construction. There are two condominium buildings within the settlement zone at the intersection of Adobe Creek and Alma Street.

The typical residence along Adobe Creek is referred to as an "Eichler" home. These structures consist of a concrete slab-on-grade foundation and a wood-framed superstructure. Many of the houses have large plate glass windows and sliding glass doors. The houses were constructed with radiant heating systems, consisting of copper or galvanized steel tubing embedded in the concrete slab-on-grade. To provide heat, hot water circulates through the tubing.

Ground settlement could cause cracking of the concrete slab-on-grade foundation system, and possibly architectural cracks in the interior walls or exterior siding. Structural damage to the wood frame superstructure is unlikely. Damage to the slab-on-grade may cause rupturing of the radiant heat tubing thus making the heating system inoperative. This could lead to additional settlement if the subgrade below the slab-on-grade became saturated from leaks in the heating system.

### SWIMMING POOLS

Eight swimming pools are within the zone of potential settlement. Seven of the pools are concrete lined, either rectangular, oval, or kidney-shaped. Potential impacts to the concrete or masonry pools include rotation or tilting of the pool walls leading to the cracks in the masonry. Fiberglass pool walls may also crack due to shifting and rotating of

## Table 3
## POTENTIALLY IMPACTED HOUSES
## PROPOSED ADOBE CREEK IMPROVEMENTS
## Palo Alto, California

| Name | Address | Approx. Creek Station | Approx. Distance From Exist. Top-of-Bank (ft) | Field Visit | Comments |
|---|---|---|---|---|---|
| Justice | 465 El Capitain Pl. | 198+00 | 4 | * | 2-ft overhang |
| Becker | 455 El Capitain Pl. | 198+00 | 7 | * | 2-ft overhang |
| Liang | 3990 Duncan Pl. | 199+00 | 9 | * | |
| Van de Put | 3954 Nelson Ct. | 200+50 | 3 | | |
| Wheeler | 3956 Nelson Ct. | 201+00 | 5 | * | 2-ft overhang |
| Lindholm | 411 Adobe Pl. | 203+00 | 6 | * | 2-ft overhang |
| Fung | 3934 Duncan Pl. | 205+00 | 14 | * | Addition to house closest to creek. |
| Morris | 345 Creekside Dr. | 206+00 | 10 | * | Cracks in floor slab - radient heat operable. |
| Olmstead | 331 Creekside Dr. | 206+50 | 10 | * | 2-ft overhang |
| Barnes | 317 Creekside Dr. | 207+00 | 2 | * | 2-ft overhang |
| Morrison | 3902 Duncan Pl. | 208+50 | 8 | * | |
| Wall | 291 Creekside Dr. | 209+00 | 6 | * | |
| Haines | 281 Creekside Dr. | 210+00 | 6 | * | Baseboard heat - not in slab, 2-ft. overhang. |
| Vanderiet | 271 Creekside Dr. | 211+00 | 2 | | |
| Straehnke | 3895 Mumford Pl. | 211+50 | 14 | * | |
| Brann | 251 Creekside Dr. | 212+00 | 11 | * | 2-ft overhang |
| Elspas | 130 Ely Pl. | 217+00 | 8 | | |
| Okner | 207 Creekside Dr. | 214+50 | 15 | | |
| Gilberg | 209 Creekside Dr. | 215+00 | 14 | | |
| Wenner ("Tract 4927") | 135 Green Meadow Way | | 5 | * | 2-ft overhang |
| Kennedy ("Tract 4927") | 119 Green Meadow Way | 219+00 | 6 | * | 6-ft overhang |
| Drapkin | 3943 Alma St. | 219+00 | 15 | * | |
| Stietzel | 239 Whitclem Ct. | 224+50 | 18 | | |

SF07/005.50

## Table 4
## POTENTIALLY IMPACTED STRUCTURES (OTHER THAN HOUSES)
## PROPOSED ADOBE CREEK IMPROVEMENTS
## Palo Alto, California

| Name | Address | Approx. Creek Station | Type of Structure | Approx. Distance From Existing Creek Top-of-Bank (ft.) |
|---|---|---|---|---|
| Justice | 465 El Capitain Pl. | 198+00 | Small office, separate from house, along fence | 2 |
| Kirkeby | 3998 Duncan Pl. | 198+00 | Pool 7-ft wide patio between pool and channel aluminum shed | 4 |
| Liang | 3990 Duncan Pl. | 199+00 | Swimming pool-plastic liner with sand backfill 30ftx12ftx8ft pool pump, fittings, underground pipes along fence concrete patio | 8 |
| Preston | 3918 Duncan Pl. | 207+00 | Concrete-lined pool concrete patio between pool and fence | 10 |
| Morrison | 3902 Duncan Pl. | 208+50 | Concrete-lined pool concrete patio to fence, fence supports small wood overhang | 6 |
| Grandberg | 3875 Mumford Pl. | 210+00 | Concrete-lined pool 30ftx15ftx8ft 3-ft. wide patio on channel side of pool, piping and equipment | 15 |
| Berwald | 261 Creekside Dr. | 211+50 | Pool | 5 |
| Straehnke | 3895 Mumford Pl. | 211+50 | Concrete-lined pool, ornamental weaving along fence, pool pump & equipment along fence, solar heating pipes on fence, concrete patio between pool & fence | 3 |
| Cooke | 131 Green Meadow Way | 219+00 | Concrete-lined pool 8-ft patio between pool and channel, wood bench, circular sun deck | 4 |

the surrounding ground. The eighth pool (at the Liang residence) was constructed with a plastic liner backfilled with sand. According to the owner, the water is holding up the sides of the pool, which has never been drained. Construction vibrations may cause settlement or shifting of the sand backfill, thus distorting or damaging the plastic liner.

## UTILITIES

Several of the properties have underground utilities running along the back fence. Additionally, there are overhead utilities crossing the creek at virtually every residence. These overhead utilities are shown in the SCVWD preliminary engineering plans.

SF07/002E.50

## MITIGATION

General mitigative measures to help reduce the short- and long-term impacts are discussed in this section. These mitigative measures can be used either alone, or in combination, depending on the potentially impacted property.

### PRE- AND POST-CONSTRUCTION SURVEY

A survey of all potentially impacted structures should be performed before construction begins to assess the pre-construction condition of the structures. This survey should include photographing existing structures and documenting existing cracks or other damage. The same impacted structures should be surveyed after construction is complete. Information obtained from the post-construction survey should be compared to the pre-construction survey in order to evaluate the impacts, if any, on the existing structures. The surveys should be performed by a qualified civil engineer.

### MONITORING

Throughout the construction period, various monitoring devices should be installed and measured periodically. The monitoring devices can help detect ground movement or vibrations, so that remedial measures can be taken if settlement or vibrations become excessive. The exact location and frequency of measurement of the monitoring devices should be determined during final design of the project. The monitoring devices should include the following:

- Settlement monuments at various distances from the construction activity, and at strategic locations near potentially impacted structures.
- Boring cased with inclinometer casing near the excavation wall in the most critical areas to permit measurement of lateral ground deformation that may result from the proposed excavation and permanent wall.
- Vibration monitors installed on or near the potentially impacted structures to measure vibration intensity during pile driving and demolition.

After construction is complete, and the permanent channel wall is built, the settlement monuments and slope inclinometers should be measured periodically to help detect potential long-term movement of the channel wall and surrounding ground.

## PROTECT EXISTING STRUCTURES

Several remedial measures should be taken prior to construction to protect the existing structures. Strong tape should be put across the plate glass windows and sliding glass doors to help reinforce and protect the glass from excessive vibration. Swimming pools within the potential settlement zone should be drained prior to construction. Smaller structures, such as sheds, wood fences, and swimming pool pumps and equipment, should be removed and replaced after construction is complete. Underground and overhead utilities should be temporarily relocated during construction if they obstruct the construction operations.

The house foundations could be underpinned with grout prior to construction to strengthen the foundation subgrade and protect it from excessive settlement and lateral movement. This mitigative measure would be most effective for the houses closest to the channel, say within 5 to 10 feet. Several of the most critical houses could be underpinned prior to construction. Other potentially impacted structures would be carefully monitored. If excessive ground movement is detected, underpinning would then be done. The underpinning procedure consists of drilling holes on a grid adjacent to and below (with inclined borings) the foundation. Grout is injected under pressure and the foundation soil is displaced by grout with a resulting increase in density and strength. Grouting would cause some disruption of landscaping and patios that would need to be repaired. Care would need to be taken during underpinning to prevent the structure from rising as a result of excessive grout pressure.

## SHORING AND BRACING SYSTEM

The shoring and bracing should be designed and installed specifically to control ground movement. This would include an adequately stiff wall and sufficient bracing. Alternative bracing systems, such as a tied-back wall, should be considered. A tied-back wall would require an encroachment permit from the adjacent property owners. Monitoring of potential ground movement should be required throughout the construction period as described above. As was stated previously, the "permissible" amount of ground movement, i.e., the largest ground movement that could occur without damaging houses or other structures, is highly dependent on the type and condition of the structure, and the local soil conditions.

## REPAIR/REPLACE IMPACTED STRUCTURES

This mitigative measure involves allowing some damage to existing structures, and then repairing any damage that may occur. The pre-construction survey would be useful in identifying the level of effort required to repair or replace the structures. This alternative would lend itself primarily to smaller structures that would not be difficult or expensive to repair, or, in the worst case, replace outright. As an example, damaged radiant heating systems would most likely have to be replaced with an alternative source of heating, such as baseboard radiant heat. Similarly, swimming pools could be repaired or replaced. We anticipate that the plastic-lined pool will be need to be replaced.

SF07/002C.50

# REFERENCES

United Soil Engineering, Inc., "Geotechnical Investigation for Adobe Creek/Barron Creek Improvements, Palo Alto, California," prepared for Santa Clara Valley Water District, January 1988.

Wahler Associates, "Geotechnical Investigation, Proposed Adobe Creek Bridge, Middlefield and Charleston Roads, Palo Alto, California," prepared for Ruth and Going, Inc., February 1988.

CH2M HILL, INC., "Geotechnical Exploration, Santa Clara Valley Water District Creek Modification Project, Part II, Adobe Creek at Alma Street, Palo Alto, California," prepared for Santa Clara Valley Water District, July 1988.

Mana, A.I. and Clough, G.W., "Prediction of Movements of Braced Cuts in Clay," Journal of The Geotechnical Division, ASCE, Vol. 107, No. GT6, June 1981, pp 759-778.

Peck, R.B., "Deep Excavations and Tunneling in Soft Ground," Proceedings, 7th International Conference on Soil Mechanics and Foundation Engineering, State-of-the-Art-Volume, 1969, pp 225-290.

Clough, G.W., "Effects of Excavation Induced Movements in Clays on Adjacent Structures," Proceedings, 11th International Conference on Soil Mechanics and Foundation Engineering, 1985.

Greensfelder, R.W., "A Map of Maximum Expected Bedrock Acceleration from Earthquakes in California." California Division of Mines and Geology, 1973.

Seed, H.B. and Idriss, I.M., "Ground Motions and Soil Liquefaction During Earthquakes," Earthquake Engineering Research Institute, 1982.

Wiss, J.F., "Vibrations During Construction Operations," Journal of the Construction Division, ASCE, No. CO3, September 1974, pp 239-246.

SF07/002D.50

# APPENDIX D

# NOISE AND AIR QUALITY ASSESSMENTS

Prepared by MO'C Physics Applied

# Adobe Creek

## Noise & Air Quality Assessments

September 1989

mo'c Physics Applied
1032 Elwell Court, room 244
Palo Alto, California 94303
(415) 968-5793

# *Contents*

Acoustical Setting

**Interpretation of Noise Levels** 1
**Standards** 3

Noise Impacts

**Construction Activities** 7

Noise Mitigation Measures

**Barriers** 11
**Hours of Construction** 12
**Equipment** 12

Air Quality Effects

**Attainment Status of the Basin** 15
**Air Pollution Phenomena** 16
**Project's Air Quality Effects** 17
**Air Quality Mitigation** 18

# Acoustical Setting

## Interpretation of Noise Levels

Noise intensity is customarily measured on a "decibel" scale which serves as an index of loudness. On this scale sounds as faint as 0 decibels are just barely audible, and only then in the absence of other louder sounds. Intense sounds of 120-140 decibels are so loud as to be painful or to cause damage to hearing with but a brief exposure.

These extremes are not encountered in commonplace environments. Outdoor noise levels along Adobe Creek are usually within the range of 40 to 60 decibels.[1]

*noise environment or event: (conditions) noise level*

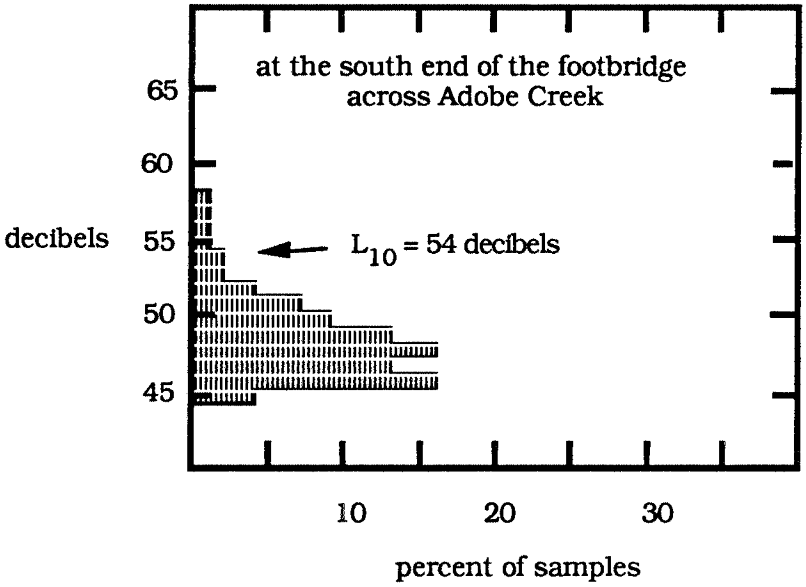
anechoic chamber: (hearing test) 0-20 decibels
recording studio: (background) 20 decibels
quiet woods: (in a rural area, still air) 30 decibels
residence: (indoors at night, quiet suburb) 35 decibels
office: (busy, open-plan) 55 decibels
normal conversation: (3 to 5-foot separation) 60-65 decibels
20 mph automobile: (25-foot separation) 65 decibels
50 mph dump truck: (50-foot separation) 90 decibels
train horn: (100-foot separation) 105 decibels
claw hammer: (on wooden plank) 120 decibels
shotgun: (at shooter's ear) 140 decibels

This report cites the City's comprehensive plan, which makes use of a certain kind of average noise level known as the $L_{10}$ exceedance level– the decibel level which is exceeded over 10% of the hour, on 10 out of every 100 samples.

---

[1] All of the noise levels given in this report– whether they are designated simply as "decibels" or not– are the result of "A-weighting". A signal from a microphone which ordinarily varies in proportion to the instantaneous sound pressure level is conditioned by this weighting procedure to represent the apparent intensity or perceived loudness of the sound rather than its true physical intensity. Decibel levels are thus adjusted to take into account the fact that human hearing is less sensitive to very low or very high-pitched sounds than it is to sounds of less extreme frequencies of a few hundred to a few thousand cycles per second. The A-weighted decibel is abbreviated "dBA".

Environmental noise levels fluctuate as trucks or buses or platoons of automobiles pass on local streets or aircraft pass overhead, sometimes by more than twenty decibels over intervals as brief as a few seconds. The maximum noise levels within any interval of time are therefore significantly higher than the $L_{10}$ over the same interval; the minimum levels are often very much lower, as is shown on the figure below.

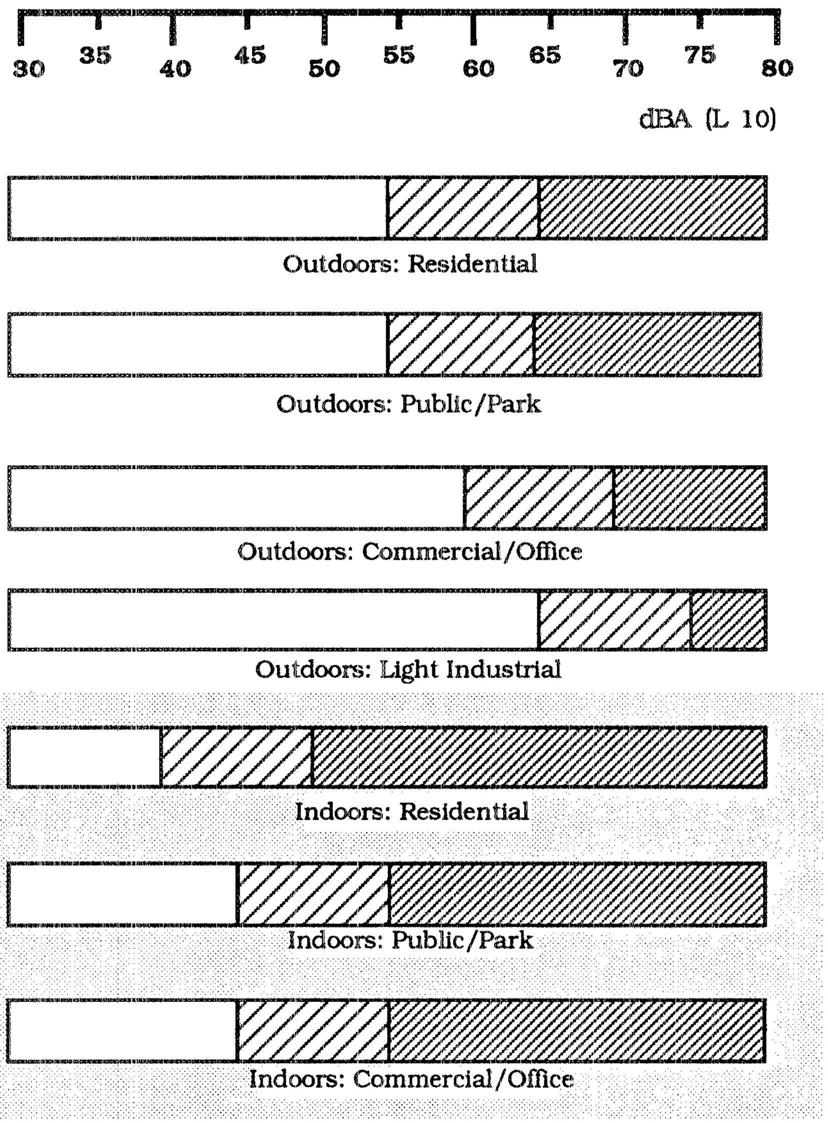


## Standards

Comprehensive Plan

The City's comprehensive plan contains guidelines for determining the compatibility of the acoustic environments of lands with their uses. Residential and public/park land uses are rated as having the highest sensitivity to noise. (Commercial/office use is deemed to be less sensitive, and light industrial uses have the lowest sensitivity rating.)

## Palo Alto Comprehensive Plan–recommended daytime L10 noise levels



The L10 noise level is the level exceeded only 10 % of the time.

□▨ Superior
▨▨ Acceptable

By comparing the noise level histogram on page 3 with the chart on the facing page it is easily seen that the back yard acoustical environments along the Creek are to be rated "superior" according to the City's comprehensive plan standards.[2]

## The City's Noise Ordinance

Noise ordinances are criminal statutes. The City's noise ordinance was revised (in 1987) after a Palo Alto police officer cited an operator of construction equipment which was being used on a municipal public works project.

The new ordinance is less stringent in application to construction equipment than to other equipment, such as "residential power equipment". It provides that "no individual piece of (construction) equipment shall produce a noise level exceeding 110 dBA at a distance of 25 feet" and that "the (total construction) noise level at any point outside of the property plane of the project shall not exceed 110 dBA", except that the latter provision is inapplicable to construction equipment which is operated by "city employees, city contractors, or public utility companies or their contractors".[3]

The ordinance limits hours of construction to 8:00 am to 8:00 pm on weekdays, 9:00 am to 8:00 pm on Saturdays and 10:00 am to 6:00 pm on Sundays and holidays.

---

[2] Of course the residences along Alma Street and Charleston Road (at the limit points of the project) are affected by roadway noise and do not enjoy such a good environment, but the noise levels of the histogram on page 3 are typical of the environments of the majority of the residences along the Creek within the section which is to be improved. The City's comprehensive plan noise standards are not intended to govern construction noise. Nonetheless, they represent policy goals and provide a frame of reference for the assessment of noise impacts.

[3] See Chapter 9.10, § 9.10.060 (d). The wording of sub-part (d) is apparently ambiguous. This is the consultant's interpretation.

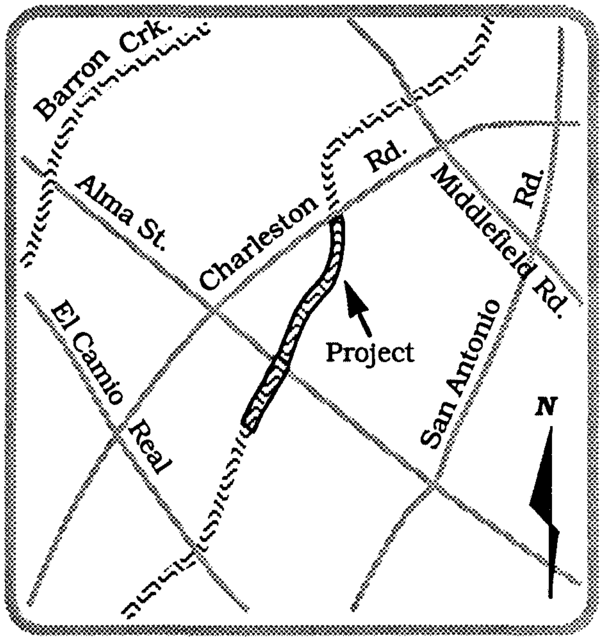
Exceptions to any of the provisions of the ordinance are allowed if "diligent investigation of available noise abatement techniques indicates that immediate compliance... would be impractical or unreasonable", in which cases permits can be issued "with appropriate conditions to minimize the public detriment".

Such permits are issued on the authority of the city manager. There is no provision for a public hearing or for notice to the public, but aggrieved persons may appeal to the city council.[4]

---

[4] See § 9.10.070 of the ordinance.

# Noise Impacts



## Construction Activities

The project would consist of reconstruction of the concrete creek bed, replacing the existing trapezoidal prism bed with a "U" channel. The walls of the new channel would extend several feet above the surface of the adjacent ground, so as to form a flood wall.

The construction would take as much as two construction seasons (April to October). The activities could consist of:

- removal of trees and other structures in adjacent backyards
- removal of backyard fences
- installation of construction fences
- drilling for soldier piles
- jackhammering & removal of existing concrete channel walls & invert
- excavation for shoring system & installation of lag boards
- loading & removal of concrete wall & invert
- pouring of channel bottom
- construction of forms for new channel walls
- pouring of concrete for new channel walls
- removal of forms
- backfilling behind new walls
- construction of new backyard fences
- removal of the footbridge
- construction of a new footbridge
- diversion of Adobe Creek flow with a pump

Diesel-powered heavy equipment, jack hammers and gasoline-powered chain saws would be used on the project. Peak noise levels from individual pieces of such equipment would often fall in the 90 to 100 decibel range at a distance of 25 feet.[5]

Noise levels change by 6 decibels for every factor of two change in distance separation from a localized source.[6] Thus a tool which gives off 95 decibels at 25 feet registers about 101 decibels at 12.5 feet and about 107 decibels at 6 feet.

---

[5] For examples of construction noise levels see: Handbook of Noise Assessment, publ. Van Norstrad Reinhold, ed. Daryl N. May, 1978.

[6] i. e., from a source which is not extended and is in effect like a point in space rather than an area or a volume

The significance of this numerical progression lies in the fact that some of the work would take place along the property line, within a few feet of the residents. To state the obvious, some of the construction noise from the the project would be *very* loud and annoying.[7]

*Illustrative Noise Levels from Construction Equipment*

| equipment | noise levels at 25 feet (decibels) |
|---|---|
| backhoes | 78-99 |
| loaders | 78-90 |
| dump trucks | 89-100 |
| cement trucks | 89-100 |
| cranes | 82-93 |
| chain saws | 90-100 |
| pavement breakers | 82-92 |
| jack hammer | 88-103 |

It is also possible that pile drivers could be used, which could produce peak impact noise levels of 100-110 decibels. A pump may be used to divert creek water around the construction. The pump would operate 24 hours per day.

Of all the residences along the Creek, the worse-affected would be those at the access point for construction equipment. Of course, the likely access points are at Alma Street and at Charleston Road. The heavy equipment such as the cranes, the dump trucks and the cement trucks would be temporarily stationed near these residences to be loaded or unloaded.

---

[7] It would be loud and annoying whether or not there would be violations of the City's noise ordinance.

Smaller pieces of mobile equipment such as backhoes, loaders, dozers and pickup trucks would travel to and fro along the creek bed carrying building materials and rubble to and from the work site.

The effect of the construction would be significant temporary increases in time-averaged and peak noise levels, particularly at the residences on the Creek nearest to the access points for the construction equipment.

The construction noise levels within creekside homes would be high enough to cause significant levels of speech interference and sleep disturbance, even with the windows closed.[8]

---

[8] There would be no nighttime construction, but not everyone sleeps only at night. The pump which may be used to divert water around the construction site would run all night and might prove annoying to some even if it were well-muffled.

# Noise Mitigation Measures

## Barriers

Since the most-affected residences would be those near the access points for the construction equipment, it would be feasible to provide temporary plywood walls to shield those residences from some of the noise generated by heavy diesel road equipment such as dump trucks, cranes and cement trucks.

This approach would be most feasible and effective at the residence on Alma Street on the east side of the Creek and at the residences on Charleston Road on both sides of the Creek. (The other residence on Alma Street on the west side of the Creek is well set back from the Street and so would not be as affected by noise from the trucks and other heavy road equipment.)

Along the creek bank the walls should extend to a height which exceeds that of the eaves of the roofs. Where it appears feasible and effective to continue the wall around the corner of the lot, along the roadway property line, the wall there should be about 12 feet high–higher than most diesel exhaust stacks.[9] The plywood should be at least a half inch thick and the surface should be continuous.[10]

## Hours of Construction

The hours of construction which are specified by the City's noise ordinance should be observed.

## Equipment

Gasoline-powered chain saws and jackhammers are among the noisiest of the pieces of equipment which might be used on the project. It would be preferable to use pavement breakers wherever practical, in lieu of jackhammers.

---

[9] There is a garage in the corner of one of the affected properties. It would be acoustically ineffective and unnecessary and otherwise impractical to block the driveway there with a wall.

[10] Unlike interior panels, outdoor walls do not need to have sealed joints.

It also would also be preferable to use hand saws instead of gasoline-powered chain saws.[11] Pumps used to divert water around the construction work should be well-housed to reduce noise emissions.[12]

---

[11] Electrically-powered saws could also be used since generators are hardly as noisy as gasoline-powered saws and since generators could be positioned further away from the residences than the saws.

[12] The creek diversion pump equipment which would run at night should be electrically powered (by the City's power lines) and should have an airtight enclosure with an absorptive lining.

# Air Quality Effects

**Attainment Status of the Basin**

The Federal clean air act deadline was extended by the 100th Congress to August 31st of 1988. By that date clean air standards had not been attained in the San Francisco Bay area, which still has exceedances of Federal standards for ozone and carbon monoxide.

## Air Pollution Phenomena

### Ozone

Episodes of high ozone concentrations occur during summer months on warm sunny days in which there is a strong "temperature inversion" aloft which caps the height to which surface-released contaminants can be dispersed.

Ozone is a gas which is not directly emitted as a component of flue gas or engine exhaust. It is instead a product of a complex set of chemical reactions between oxides of nitrogen and certain organic (hydrocarbon) compounds– precursors which *are* in flue gas and engine exhaust. The photochemical reactions which produce ozone do not occur instantaneously. It takes more than an hour from the time of emission of the precursors for significant concentrations of ozone to develop. Because of this delay ozone is not particularly evident near roadways or industrial plants where precursor compounds are emitted.

Thus the ozone concentrations in Palo Alto are principally imported from San Mateo County, and emissions of ozone precursors from Palo Alto affect communities to the south.

Concentrations of ozone exceed the Federal standard of 0.12 parts per million (averaged over one hour) once or twice every year or two at the Bay Area Air Quality Management District monitoring station in Redwood City.

Carbon Monoxide

The phenomenon of carbon monoxide episodes is quite different. This pollutant is principally emitted directly as a component of vehicular tailpipe effluence. The season for carbon monoxide is winter; peak hourly concentrations are found during the traffic commute periods and, sometimes, in late evening.

Exceedances of the Federal standard of 9.0 ppm (averaged over 8-hours) do occur in Palo Alto every winter or two.[13]

Particulates

The State's new particulate standard pertains only to particles which have a diameter of less than 50 millionths of a meter. The standard is exceeded if concentrations of such particles exceed 50 micrograms per cubic meter of air over any 24-hour period. Exceedances occur frequently throughout much of the State. Exceedances are found to occur once every few days on the Peninsula and in the south Bay area.

Small particles are among the products of combustion processes, but resuspension of roadway dust accounts for most airborne particulate matter.

### Project's Air Quality Effects

Carbon Monoxide

The project would not affect episodal carbon monoxide concentrations because there would be very little work done in winter, the season for carbon monoxide.

---

[13] The City commissioned a field study of carbon monoxide which took place in the winter of 1985-86. Two exceedances of the Federal standard were found in a three month period.

Ozone

The project would not cause local concentrations of ozone to be increased because ozone is not a component of engine exhaust. Emissions of ozone precursors from construction equipment would contribute to the development of ozone concentrations downwind, but their effect would be undetectable.

This is easily seen by noting that the pieces of construction equipment in use along the creek bed would number about as many as vehicles on a busy street, and a rather short section of street at that. The emissions would clearly be minuscule in comparison with all the emissions from Palo Alto.

Particulates

The concrete creek bed would be almost completely dry during the construction. Dust would be raised by the vehicles traveling up and down the creek bed to and from the work site. Some of the other equipment could cause some dust to be raised (e. g., pavement breakers).

## Air Quality Mitigation

Dust could be mitigated by sweeping or washing the concrete creek bed as needed.

# APPENDIX E

## ALTERNATIVES ANALYSIS/ SUPPLEMENT TO ALTERNATIVES ANALYSIS

Prepared by Santa Clara Valley Water District

**SANTA CLARA VALLEY WATER DISTRICT**

# ADOBE CREEK PHASE IV
# FLOOD CONTROL ALTERNATIVE ANALYSIS
# ALMA STREET TO EL CAMINO REAL

prepared by

David E. Hook, P.E.
Associate Civil Engineer
with
Kurt Flammer
Assistant Civil Engineer

under the direction of

James M. Fiedler, P.E.
Senior Engineer, Design Division

John T. O'Halloran
General Manager

Robert R. Smith
Flood Control Manager

June 21, 1989

# TABLE OF CONTENTS

Page

Preface....1
Summary....2

Project Alternatives

1. 20 Foot to 17 Foot Wide U-frame Channel (preferred alternative)....4
2. No Project....13
3. Floodwalls with 17-Foot U-frame Channel....14
4. Adobe Creek Bypass....17
5. Upstream Storage....24
6. Diversion....39

BIBLIOGRAPHY....54

APPENDICES

1. Cost Estimate for Preferred Alternative (17'/20' U-frame Channel)
2. Freeboard
3. Hydrographs

FIGURES

1-4. 20'/17' Foot U-frame Channel - Cross-sections....5-8
5. 20'/17' U-frame Channel - Water Surface Profile....9
6&7. Floodwalls with 17' U-frame Channel - Cross-sections....15
8. Adobe Creek Bypass Alignment....18
9&10. Bypass Box Culvert - Cross-sections....20-21
11. Hidden Villa Dam Site....25
12. Not Included
13. Foothill College Dam Site....29
14. Terman Jr. High School and Alta Mesa Cemetery Dam Sites....33
15. Adobe Creek Diversion Alignment....40
16. Matadero Creek (PAFB to Ross Road) - Cross-Section....43

TABLES

1. Comparative Summary of Project Alternatives....3
2. Channel Wall Heights - 20'/17' U-Frame Channel.10-11

# Preface

Homeowners adjacent to Adobe Creek between Alma Street and Charleston Road have questioned the choice of flood control measures in this reach of channel. They have asked the District to present the alternatives for flood control in this reach of Adobe Creek.

This report presents these alternatives.

## SUMMARY

This report contains a description of the flood control alternatives for Adobe Creek between Charleston Road and Alma Street.

The preferred alternative is the 20 foot/17 foot U-frame channel, which requires complete replacement of the channel in this reach.

The other alternatives considered are: no project; floodwalls/17 foot U-frame; a bypass; upstream storage; and diversion of excess flow to Matadero Creek.

The preferred alternative has been chosen due to moderate wall heights and visual impacts, moderate cost, minimal long term environmental impacts, stable hydraulics, and lack of negative impacts on local drainage.

See Table 1 for a summary of the factors affecting the choice of the 20 foot/17 foot U-frame channel as the preferred alternative.

# ADOBE CREEK PHASE IV
# COMPARATIVE SUMMARY OF PROJECT ALTERNATIVES

**TABLE 1**

| | *Preferred Alternative* | | | | | |
|---|---|---|---|---|---|---|
| ISSUES & CONCERNS | 17'/20' U-FRAME | NO PROJECT | FLOODWALLS/ 17' U-FRAME | BYPASS | UPSTREAM STORAGE | DIVERSION |
| (1) PROJECT COST | $5.8 million | $3 1 million/year, or $30 million in 1% flood | $4 million | $12 million | $30 - $40 million | $49 million |
| (2) PHYSICAL ENVIRONMENT | | | | | | |
| (A) GENERAL DESCRIPTION | Replace channel between Charleston & 800' u/s of SPTC. Replace SPTC culvert & modify Alma Culvert. | Flooding will continue | Install floodwalls for 1600' u/s of Charleston; Replace rest of Channel and culverts per 17'/20' U-frame. | Install RCB along Alma to Charleston, and along Charleston to Adobe Creek. | Store portion or all of excess channel flow in Reservoirs upstream. | Divert excess flow to Matadero Creek, & upsize Matadero Creek. |
| (B) LOCAL DRAINAGE | No significant change. in local storm drainage | No change in local storm drainage. | Severely impacted due to water surface well above ground. | No change in local storm drainage. | No change in local storm drainage. | No change in local storm drainage. |
| (C) ROADS & BRIDGES | See above. | None | See above | Extreme construction impact on Charleston Road. Replace Charleston Road bridge. | Depends upon reservoir site. | Replace most bridges on Matadero Creek, per 1988 Engineer's Report. |
| (D) UTILITIES | Minor impacts. | None | Minor Impacts. | Major utility relocation crossing Alma & on Charleston Road. | Depends upon reservoir site. | Significant impacts. |
| (E) TRAFFIC | Minor impacts. | None | Minor Impacts. | Significant traffic impacts. | Significant traffic impacts. | Significant traffic impacts. |
| (F) RIGHT OF WAY | No additional r/w needed. | No additional r/w needed. | No additional r/w needed. | Additional r/w needed along SPTC and two other locations. | 20 to 70 acres needed. | Additional r/w needed from Alta Mesa Cemetary. |
| (G) OTHER | Significant construction impacts along creek. 5 ft maximum wall height. | Flooding will continue. | 9' max. floodwalls, significant construction impacts along creek. | Significant construction impacts along bypass. | Significant construction and long term impacts. | Significant construction and long term impacts. |

# 20 FOOT/17 FOOT WIDE U-FRAME CHANNEL ALTERNATIVE
## (The Preferred Alternative)

### Background

This alternative consists of the removal and replacement of the existing trapezoidal concrete channel with a U-frame concrete channel, from Charleston Road to 800 foot upstream of Alma Street (within the available right of way between the existing fences). The Alma Street bridge would be modified and the SPTC culvert replaced.

The chief aims of this alternative are to: (1) provide a stable water surface profile that would not impact local drainage; (2) keep channel walls below existing fence heights; and (3) keep the channel between existing backyard fences and not utilize the full width of the District's right of way for flood control purposes.

### Design Flow

The design flow in Adobe Creek between Alma Street and Charleston Road is 3100 cfs (Adobe Creek Hydrology Report, Bibliography, Ref. #1).

### Configuration

The existing trapezoidal concrete channel lining would be removed and shoring installed to support the excavation for the U-frame channel. A 20 foot wide concrete U-frame channel would be installed from Charleston Road to 1500 feet upstream. The channel would transition into a 17 foot wide U-frame channel for another 1600 feet. See Figures 1 and 2 for cross-sections. This would allow the enlargement of backyards adjacent to the 17 foot U-frame channel after construction.

The Alma Street culvert would be modified, and the Southern Pacific Transportation Company (SPTC) culvert would be replaced (see Figures 3 and 4). This would avoid significant traffic impacts due to the replacement of the Alma Street bridge.

### Water Surface Profile

See Figure 5 for a water surface profile. The maximum wall height is 5 foot. See Table 2 for wall heights along the channel, by station and property owner.

A lower water surface, with lower wall heights, could have been obtained through the use a wider trapezoidal channel cross section. However, these measures would have required the permanent use of the District's 30 foot right of way between Alma Street and Charleston Road.

# Adobe Creek Phase IV
## Preferred Alternative
## Wall Heights

## TABLE 2

| STATION (FEET) | CHANNEL LENGTH (FEET) | WEST BANK RESIDENTS | EAST BANK RESIDENTS | WALL HEIGHTS ABOVE EXISTING TOP OF BANK (IN FEET) 17 & 20 FT U-FRAME CH. |
|---|---|---|---|---|
| 196+86 | | BEGIN PROJECT UPSTREAM | | 1.8 |
| | 31 | OF CHARLESTON ROAD | | |
| 197+17 | | | | 1.7 |
| | | AHRENS | DOWNS | |
| | 288 | KIRKEBY | JUSTICE | |
| | | LIANG | BECKER | |
| | | | GOLDEN | |
| 200+05 | | | | 2.6 |
| | | LIANG | GOLDEN | |
| | 152 | LOBATO | KADIS | |
| | | LUBOW | DESSAIN | |
| | | | WHEELER | |
| 201+57 | | | | 3.4 |
| | 51 | LUBOW | WHEELER | |
| | | SCHNITZER | HELLER | |
| 202+08 | | | | 4.0 |
| | | SCHNITZER | HELLER | |
| | | DAU | THOMPSON | |
| | 257 | COLLINS | LINDHOLM | |
| | | JOHNSON | WANG | |
| | | FUNG | | |
| 204+65 | | | | 3.6 |
| | | FUNG | WANG | |
| | 57 | | BOEHRS | |
| 205+22 | | | | 3.8 |
| | | FUNG | BOEHRS | |
| | 63 | PUTNUM | MORRIS | |
| 205+85 | | | | 3.7 |
| | 33 | PUTNUM | MORRIS | |
| 206+18 | | | | 3.4 |
| | | PUTNUM | MORRIS | |
| | 207 | PRESTON | OLMSTEAD | |
| | | KYLE | BARNES | |
| | | | PORTER | |
| 208+25 | | EXISTING FOOTBRIDGE CROSSING | | 2.2 |
| - | | MORRISON | FAY | |
| | 109 | | WALL | |
| 209+34 | | | | 1.8 |
| | | CITY OF | WALL | |
| | 39 | PALO ALTO | HAINES | |
| | | GRANDBURG | | |
| 209+73 | | | | 1.9 |
| | | GRANDBURG | HAINES | |
| | 121 | TINCHER | VAN DE RIET | |
| 210+94 | | | | 4.9 |

| STATION (FEET) | CHANNEL LENGTH (FEET) | WEST BANK RESIDENTS | EAST BANK RESIDENTS | WALL HEIGHTS ABOVE EXISTING TOP OF BANK (IN FEET) 17 & 20 FT U-FRAME CH. |
|---|---|---|---|---|
| 210+94 | | | | 4.9 |
| | 16 | TINCHER | BERWALD | |
| 211+10 | | | | 4.8 |
| | | TINCHER | BERWALD | |
| | 10 | STAEHNKE | | |
| 211+20 | | | | 4.8 |
| | | STAEHNKE | BERWALD | |
| | 54 | | BRANN | |
| 211+74 | | | | 4.5 |
| | 36 | STAEHNKE | BRANN | |
| 212+10 | | | | 4.4 |
| | 32 | STAEHNKE | BRANN | |
| 212+42 | | | | 3.4 |
| | | BERG | PALMER | |
| | 109 | SCHMITZ | WAGNER | |
| 213+51 | | | | 3.4 |
| | | SCHMITZ | WAGNER | |
| | 58 | | SHAPERO | |
| 214+09 | | | | 3.8 |
| | | SCHMITZ | SHAPERO | |
| | 201 | HART | OKNER | |
| | | GLAUZ | GILBARG | |
| | | NORBERG | TILTON | |
| 216+10 | | | | 2.3 |
| | | NORBERG | TILTON | |
| | 96 | ELSPAS | TAO | |
| 217+06 | | | | 3.2 |
| | | ELSPAS | TAO | |
| | 102 | DRAPKIN | TRACT 4927 | |
| 218+08 | | | | 2.9 |
| | 172 | DRAPKIN | TRACT 4927 | |
| 219+80 | | DOWNSTREAM FACE OF ALMA STREET | | 1.6 |

| | | | |
|---|---|---|---|
| TOTAL CHANNEL LENGTH | 2294 | WEIGHTED AVERAGE WALL HEIGHT | 3.0 |
| | | MAXIMUM WALL HEIGHT | 4.9 |

# ADOBE CREEK, PHASE IV
# U-FRAME CHANNEL

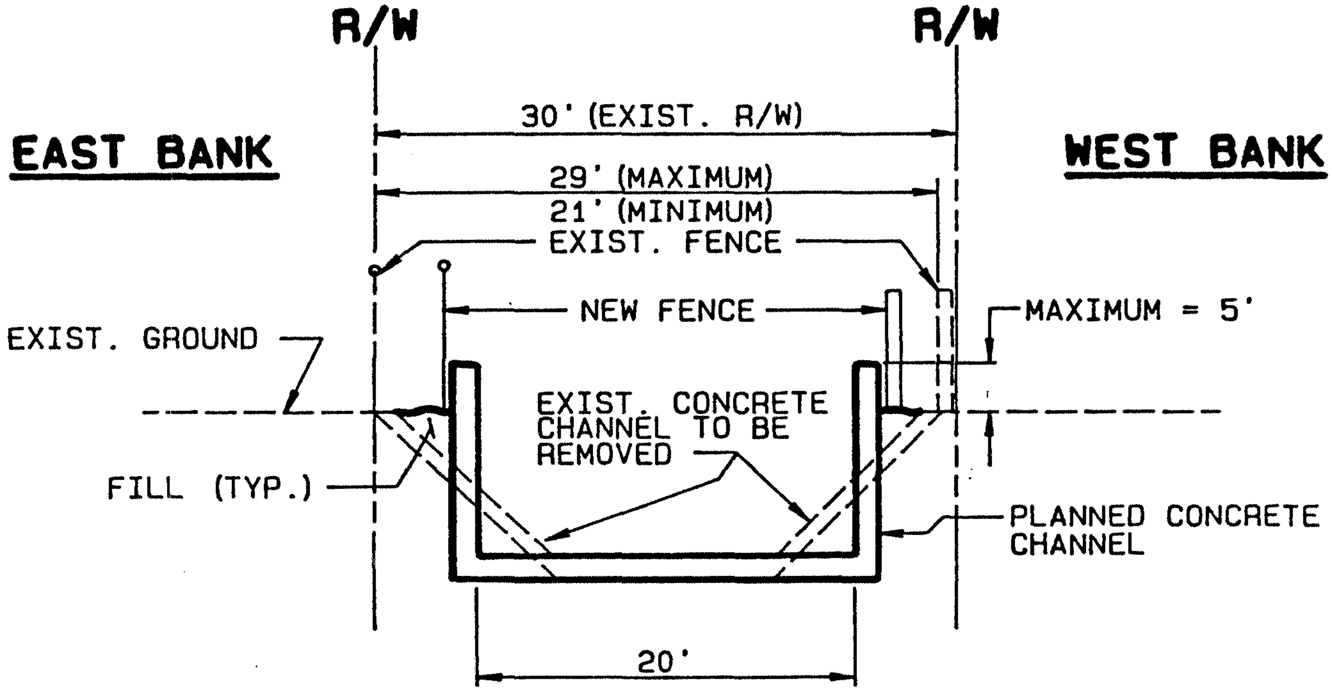


FIGURE 1

STA. 196+86 TO STA. 210+65

U-FRAME CHANNEL SECTION

# ADOBE CREEK, PHASE IV
# U-FRAME CHANNEL

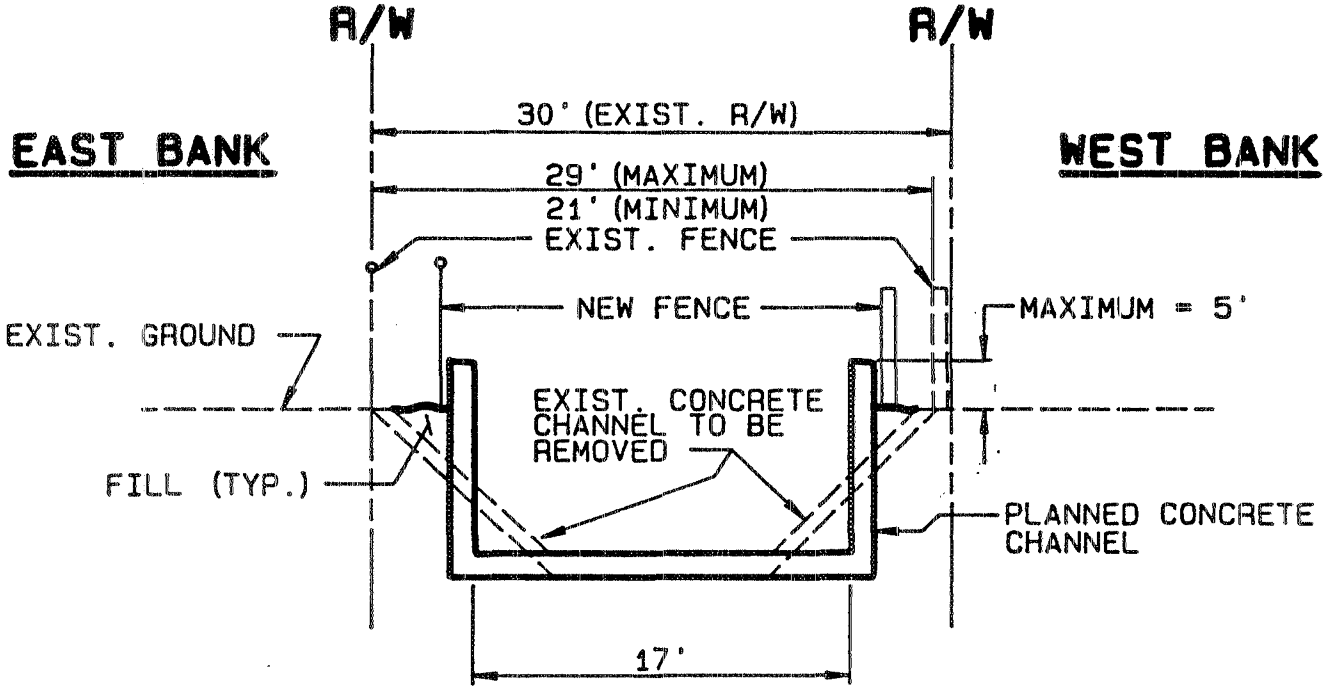
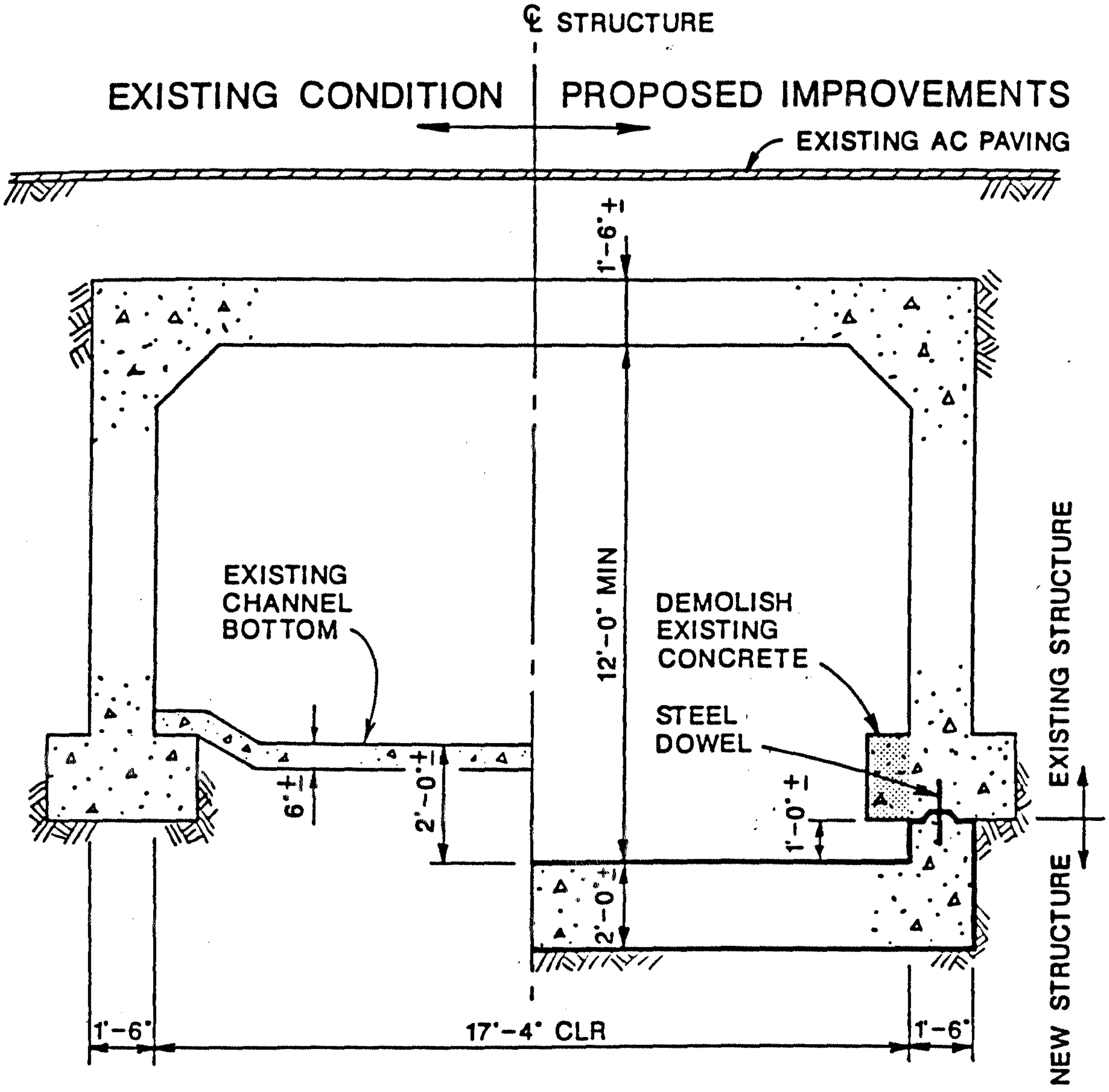


FIGURE 2

STA.210+85 TO STA.219+85

U-FRAME CHANNEL SECTION

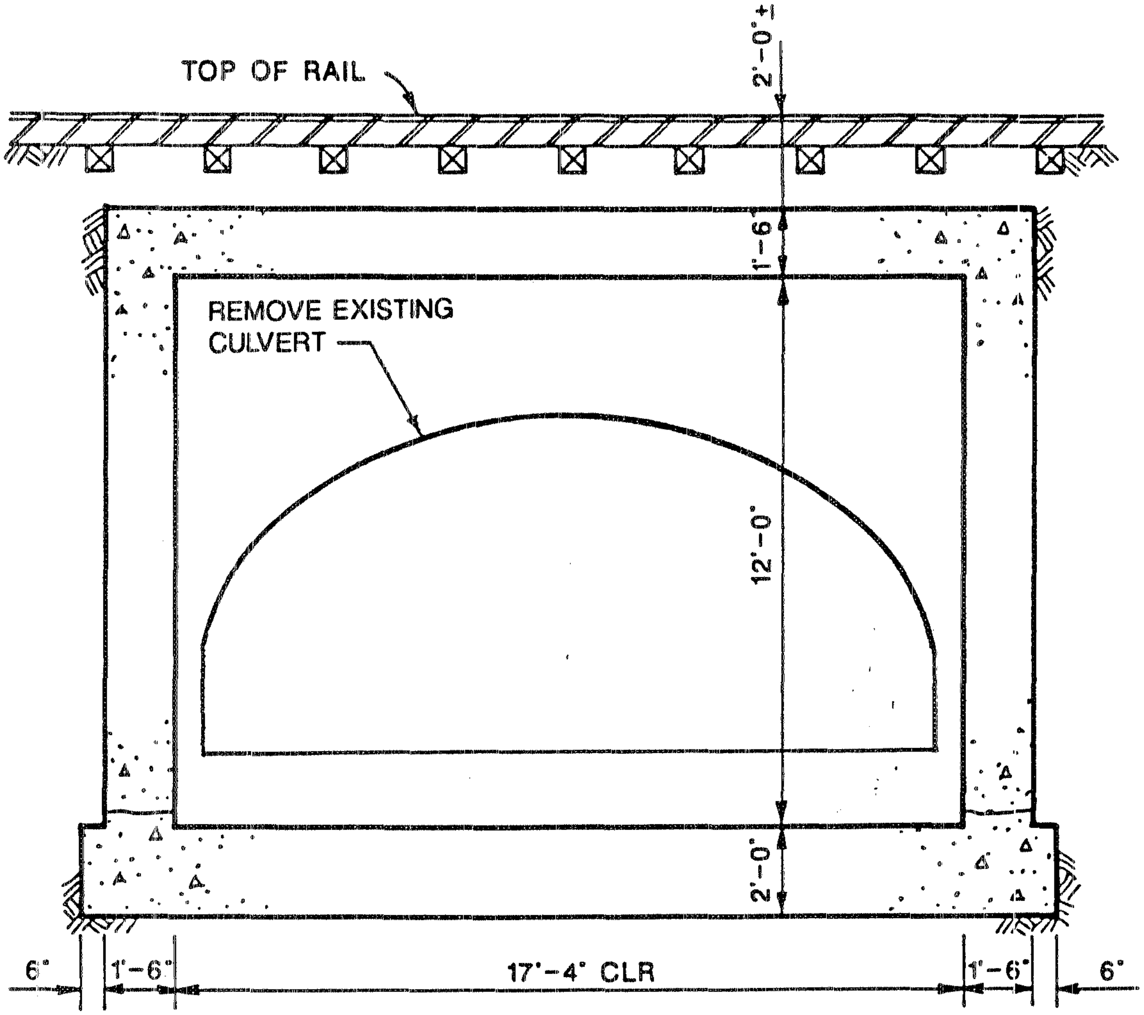


SECTION

BRIDGE MODIFICATION AT ALMA STREET

NTS

FIGURE 3



## SECTION

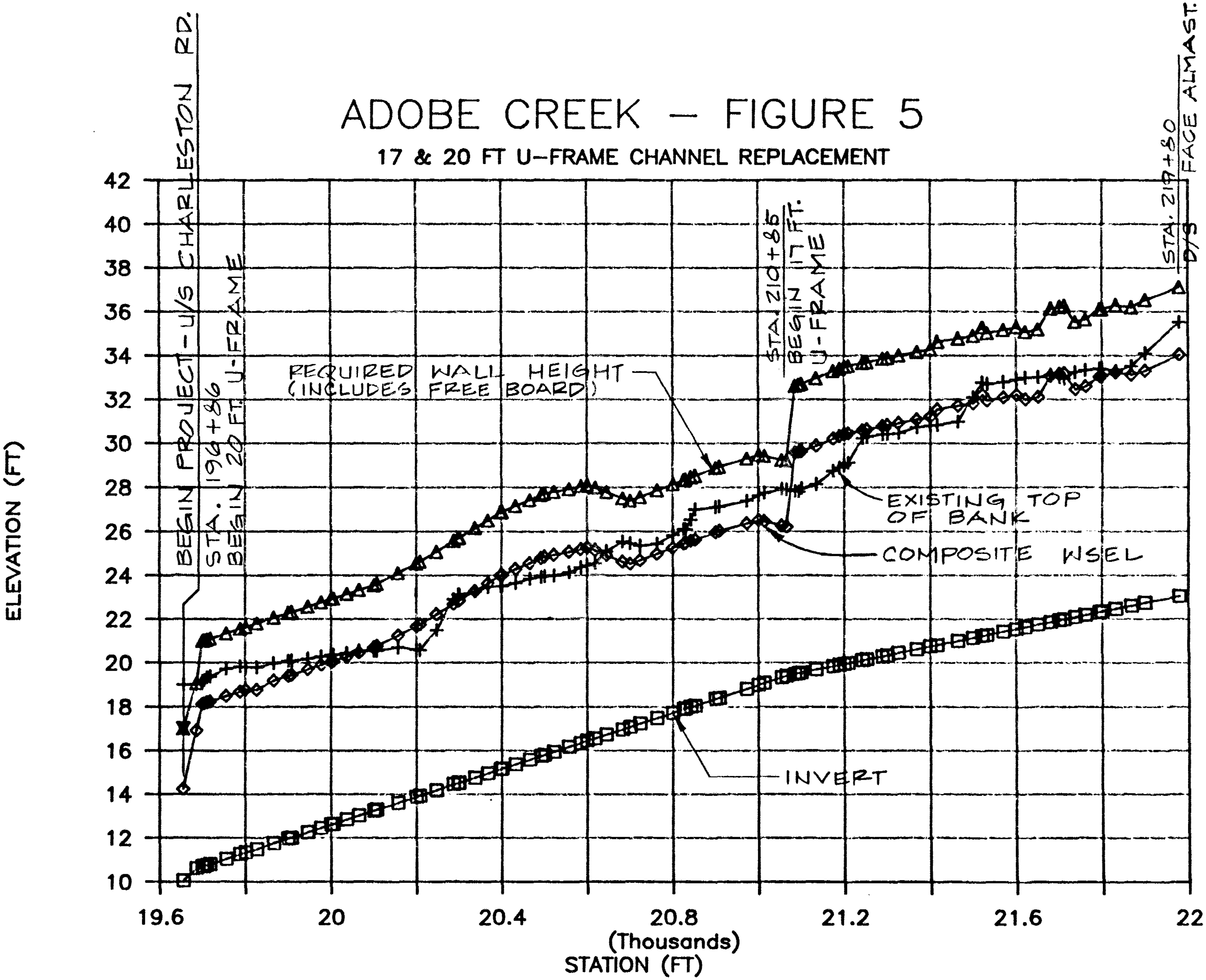
## BRIDGE AT RAILROAD CROSSING

NTS

FIGURE 4

# ADOBE CREEK – FIGURE 5

## 17 & 20 FT U–FRAME CHANNEL REPLACEMENT



## Impacts

### Construction Impacts

Noise, dust, and air pollution along the creek.

Construction vehicle access into Adobe Creek from Alma Street and Charleston Road (to work on the channel removal and replacement, and culvert modification and replacement), would impact traffic on Alma Street and Charleston Road.

Temporary removal and replacement of existing backyard fences along the channel between Alma Street and Charleston Road would be necessary for channel installation. Backyard vegetation would also be affected.

The footbridge between Duncan Place and Creekside Way would be out of service for several months during channel construction.

Installation of U-frame channel might cause damage to neighboring structures, including floor slab heating systems.

Vibrations due to pile driving, if used for shoring, could damage structures, including floor slab heating systems.

### Long Term Impacts

U-frame channel walls 5 foot or less above ground between Charleston Road and 800 feet upstream of the SPTC culvert would have a visual impact on the neighborhood.

In order to preserve privacy in the neighboring yards, the fences next to the footbridge would have to be extended.

### Cost

Costs for this alternative would include channel removal and replacement with a U-frame channel, replacement of the SPTC culvert, and modification of the Alma Street culvert, along with repair of any structural damage caused by construction.
The total cost of this alternative is $5,800,000 (see Appendix 1).

### Conclusion

The cost and construction impacts are greater than those of the floodwall/17 foot U-frame alternative. However, the advantages of moderate wall heights and visual impacts, moderate cost, minimal long term environmental impacts, stable hydraulics, and good local drainage combine to make this the preferred alternative.

## NO PROJECT ALTERNATIVE

Under this alternative, the District would construct no further flood control measures to reduce the existing flood hazard from Adobe Creek between Charleston Road and El Camino Real.

### Disadvantages

The areas upstream and downstream of the SPTC culvert would continue to be subject to flooding due to the SPTC culvert.

Residents and businesses would continue to face potential hardships due to flooding.

Flooding due to the SPTC culvert could occur on an average of once every three years. While the depth of flooding downstream of the SPTC culvert would decrease in some areas due to improvements in the culverts and channel, the extent of flooding would be largely unchanged. More than 1300 homes and apartments and 57 commercial and industrial buildings would be inundated, to depths of up to two feet.

One percent (1%) flood damages were calculated to be as high as $21 million in 1984. While the amount of damages would be reduced slightly due to the already completed channel and culvert improvements on Adobe Creek, flooding in the areas of major damage would not change. Today, the 1% flood damages would be $30 million.

Flood insurance would continue to be required for some property owners in the flood hazard zone as defined by FEMA.

### Advantages

Advantages include:

No construction impacts.

No change in local drainage.

No construction costs.

No long term impacts, except flooding.

### Conclusion

This alternative has no construction costs or impacts. However, it does not solve the flooding problems due to Adobe Creek at the SPTC culvert. This is not a feasible alternative.

## FLOODWALLS WITH 17 FOOT U-FRAME ALTERNATIVE

### Background

This alternative is a variation on that proposed in the 1985 Adobe Creek Engineer's Report (Bibliography, Ref. #3) for the reach of channel between Alma Street and Charleston Road. It is an attempt to leave the existing concrete channel intact to the greatest extent possible, while safely conveying the design flow of 3100 cfs. A secondary goal is to avoid the removal and replacement of the Alma Street bridge if possible.

### Configuration

The existing channel between Alma Street and Charleston Road is a non-prismatic trapezoidal concrete channel with several abrupt drops in the channel bottom.

In order to leave a portion of the existing channel intact with minimal modifications, the lower section will have floodwalls installed at the top of the banks, and the drops filled in (see Figure 6). This channel configuration would extend 1500 feet upstream of Charleston Road.

The next 1600 feet of channel would consist of replacing the existing trapezoidal channel with a 17 foot U-frame channel (see Figure 7). This would allow the enlargement of adjacent backyards after construction.

The Southern Pacific Transportation Company (SPTC) culvert would be replaced, and the Alma Street culvert modified (see Figures 3 and 4). This would avoid significant traffic impacts due to the replacement of the Alma Street bridge.

### Wall Height

The maximum wall height is 9.2'.

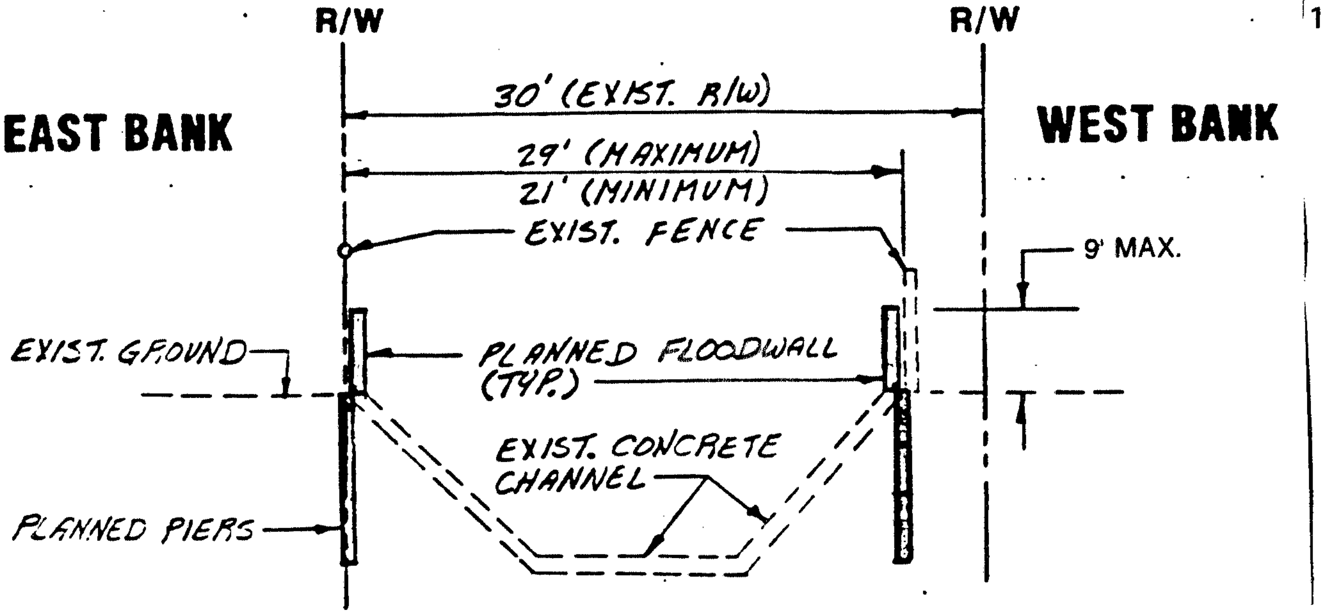
### Impacts

### Construction Impacts

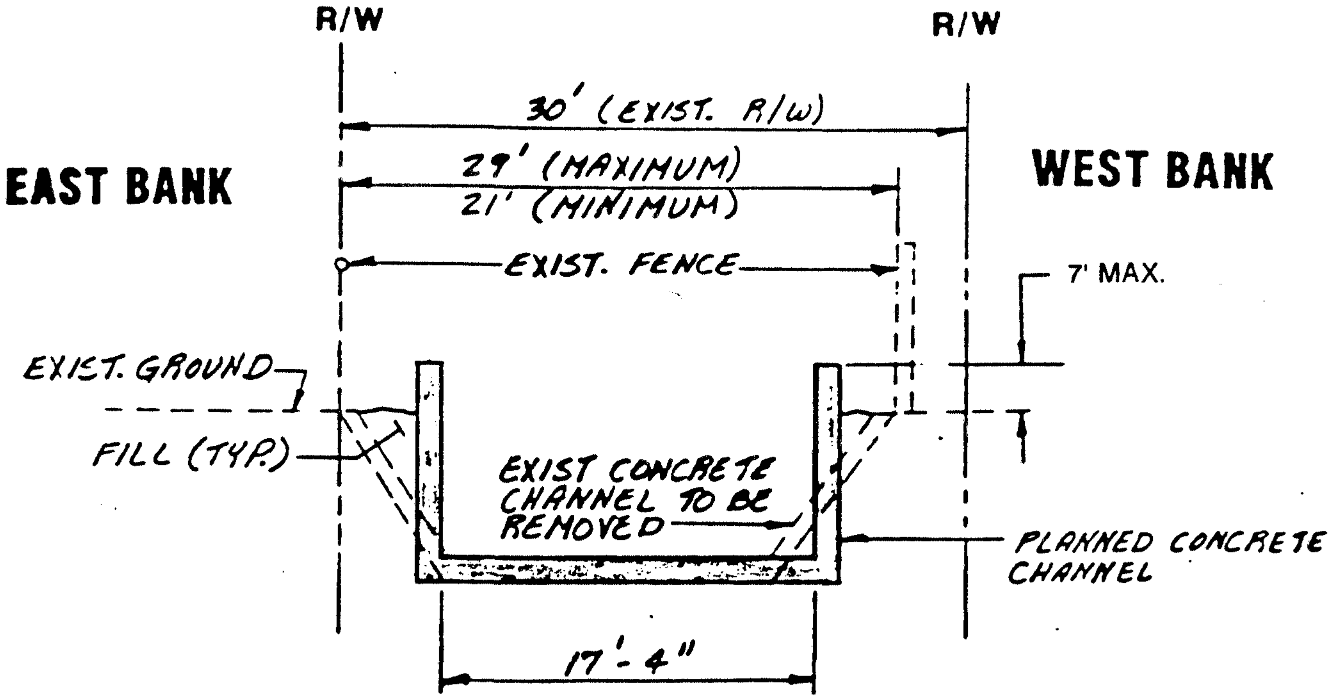
Noise, dust, and air pollution along the creek.

Construction vehicle access into Adobe Creek from Alma Street and Charleston Road (to work on the channel modification and replacement, and the culvert modification and replacement), would impact traffic on Alma Street and Charleston Road.

Temporary removal and replacement of existing backyard fences along the channel between Alma Street and Charleston Road would be necessary for floodwall and channel installation. Backyard vegetation would also be affected.



**CHANNEL SECTION - LOWER REACH**
**FIGURE 6**



**U - FRAME CHANNEL SECTION - UPPER REACH**
**FIGURE 7**

The footbridge between Duncan Place and Creekside Way would be out of service for several months during floodwall installation.

Installation of the reach of U-frame channel might cause damage to neighboring structures, including floor slab heating systems. Installation of floodwall foundations could also damage structures (such as pools) near the channel.

Vibrations due to pile driving, if used for shoring, could damage structures.

### Long Term Impacts

Floodwalls and U-frame channel walls mostly 6′ - 9′ above ground between Alma Street and Charleston Road would have a major visual impact on the neighborhood. Floodwalls 5′ high and less upstream of the SPTC culvert would impact that neighborhood.

Floodwall heights at footbridge may require ramp slopes greater than the handicapped access limit of 12:1. In order to preserve privacy in the neighboring yards, the fences next to the footbridge would have to be extended.

The water surface would be several feet above existing ground for much of this alternative. This would substantially degrade local drainage.

### Cost

Costs for this alternative would include channel modification, removal and replacement with a U-frame channel, replacement of the SPTC culvert, modification of the Alma Street culvert, and the installation of floodwalls, along with repair of any structural damages due to construction.

The total cost of this alternative is $4,000,000.

### Conclusion

While this is the least costly alternative, the high floodwalls with major visual impacts, very unstable hydraulics, and substantial degradation of the local drainage combine to make this alternative not feasible.

# ADOBE CREEK BYPASS ALTERNATIVE

The design flow in Adobe Creek between Alma Street and Charleston Road is 3100 cfs (Adobe Creek Hydrology Report, Bibliography, Ref. #1).

The Adobe Creek capacity in this reach is 1100 cfs (Adobe Creek Capacity Analysis, Bibliography, Ref. #2), with no freeboard. With freeboard acceptable to FEMA (Bibliography, Ref. #2), the channel capacity is 700 cfs. Therefore, the bypass will be sized to carry 2400 cfs.

## Bypass Alignment

By inspection of the County of Santa Clara 1" = 500′ scale aerial and planimetric drawings, the only practical route for a bypass would be along the Southern Pacific Transportation (SPTC) right-of-way to Charleston Road, across Alma St., and then along Charleston Road to Adobe Creek (see Figure 8).

The upper reach would consist of 1300′ of culvert installed between the SPTC tracks and Alma Street. The next 2000′ of culvert would be installed along the eastern side of Charleston Road to Adobe Creek.

## Grades

From the 1987 survey data and the USGS 1" = 1000′ contour map:

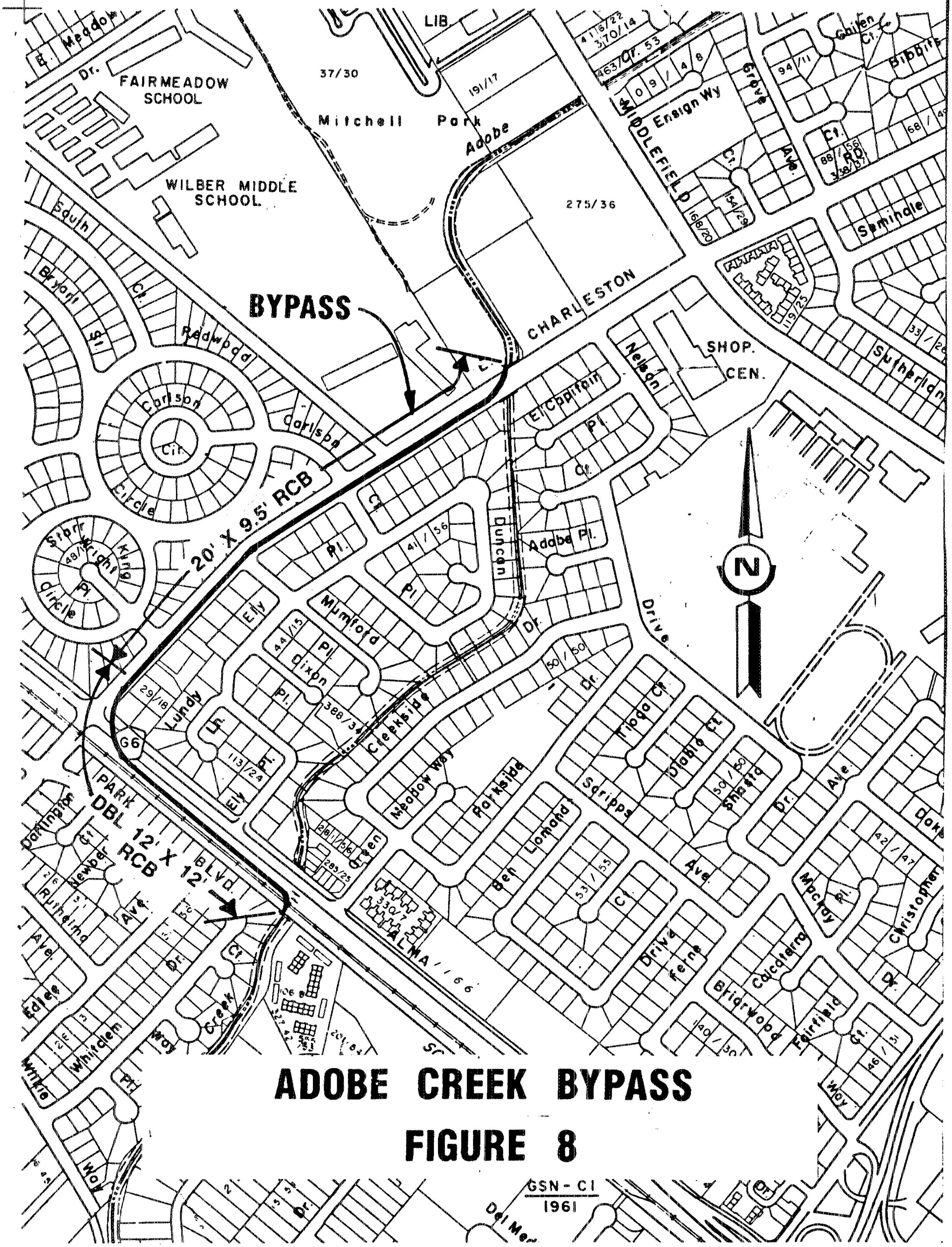
The invert at the beginning of the bypass is EL. 23′ at the SPTC tracks (to match the existing channel invert) and the existing ground surface is EL. 36.5′;

At Charleston and Alma, the existing ground surface is EL. 35′; and

At Charleston and Adobe Creek (where the bypass re-joins Adobe Creek), the creek invert is EL. 9.5′ and the ground surface is EL. 19.7′.

## Design Criteria

The design criteria for the flow in the bypass are as described in the Adobe Creek Hydraulic Capacity Analysis. Additionally, a stable flow profile, with the channel slope greater than 1.3 * Sc (critical slope) or less than 0.7 * Sc was required. Adequate freeboard was also required (refer to Appendix 2). The effects of cross-waves and superelevation were also considered.



# ADOBE CREEK BYPASS

# FIGURE 8

## Configuration

On the upper reach along Alma St., with S = 0.002, a double 12 X 12 rectangular box culvert (RCB), with normal depth Yn = 9.5′ and critical depth Yc = 6.8′, is proposed.

On the lower reach along Charleston Road, with S = 0.0053, a single 20′ X 9.5′ RCB to get adequate cover over the box for paving (Yn = 6.6′ and Yc = 7.6′) is proposed.

This configuration is the result of many attempts to balance the constraints of the existing grades, utilities, and channel inverts, and obtain a stable flow profile with adequate freeboard.

See Figures 9 and 10 for cross-sections of these reaches.

## Impacts

### Construction Impacts

Closure of a lane on Alma Street for construction access on the double RCB between Alma Street and SPTC between 9:00 am and 4:00 pm.

Removal (and re-planting with seedlings) of existing mature trees along Alma St. between Adobe Creek and Charleston Road.

Relocation of existing 3" gas line, telephone duct bank, 8" sanitary sewer, and 16" water line for Alma Street crossing (the traffic impacts for these relocations would be significant also).

Construction of the double RCB through a portion of the front yard on the southeast corner of Alma and Charleston (an easement would have to be obtained) would impact this homeowner.

Construction near the intersection of Alma and Charleston Road would significantly degrade traffic conditions at what the City of Palo Alto staff described as "the most congested intersection in Palo Alto", even if we tunneled under Alma Street.

Open cutting the Alma Street crossing would have an extreme impact on an already congested intersection. The City of Palo Alto would accept closing only one lane at a time on Alma Street if this was done.

Relocation of the existing 3" gas, street light electrical conduit, and 8" water (and installation of a parallel 8" sanitary sewer) on the eastern side of Charleston Road under the eastern sidewalk and planter strip would require removal and replacement of the existing sidewalk and park strip trees and landscaping.

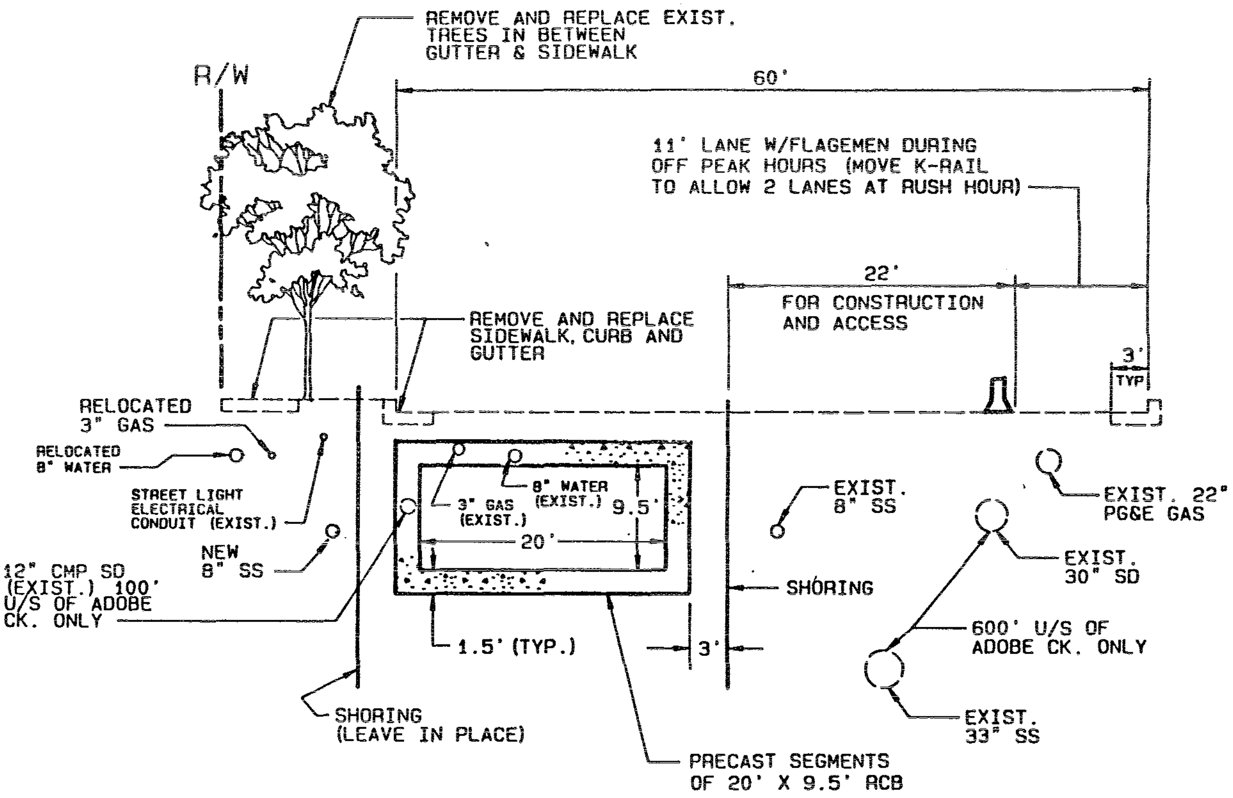

REMOVE AND REPLACE EXIST. TREES IN BETWEEN GUTTER & SIDEWALK
R/W
60'
11' LANE W/FLAGEMEN DURING OFF PEAK HOURS (MOVE K-RAIL TO ALLOW 2 LANES AT RUSH HOUR)
22'
FOR CONSTRUCTION AND ACCESS
3' TYP
REMOVE AND REPLACE SIDEWALK, CURB AND GUTTER
RELOCATED 3" GAS
RELOCATED 8" WATER
STREET LIGHT ELECTRICAL CONDUIT (EXIST.)
NEW 8" SS
12" CMP SD (EXIST.) 100' U/S OF ADOBE CK. ONLY
3" GAS (EXIST.)
8" WATER (EXIST.)
9.5'
20'
1.5' (TYP.)
3'
SHORING
SHORING (LEAVE IN PLACE)
PRECAST SEGMENTS OF 20' X 9.5' RCB
EXIST. 8" SS
EXIST. 22" PG&E GAS
EXIST. 30" SD
600' U/S OF ADOBE CK. ONLY
EXIST. 33" SS

FIGURE 9
TYPICAL SECTION-CHARLESTON ROAD
(LOWER REACH)

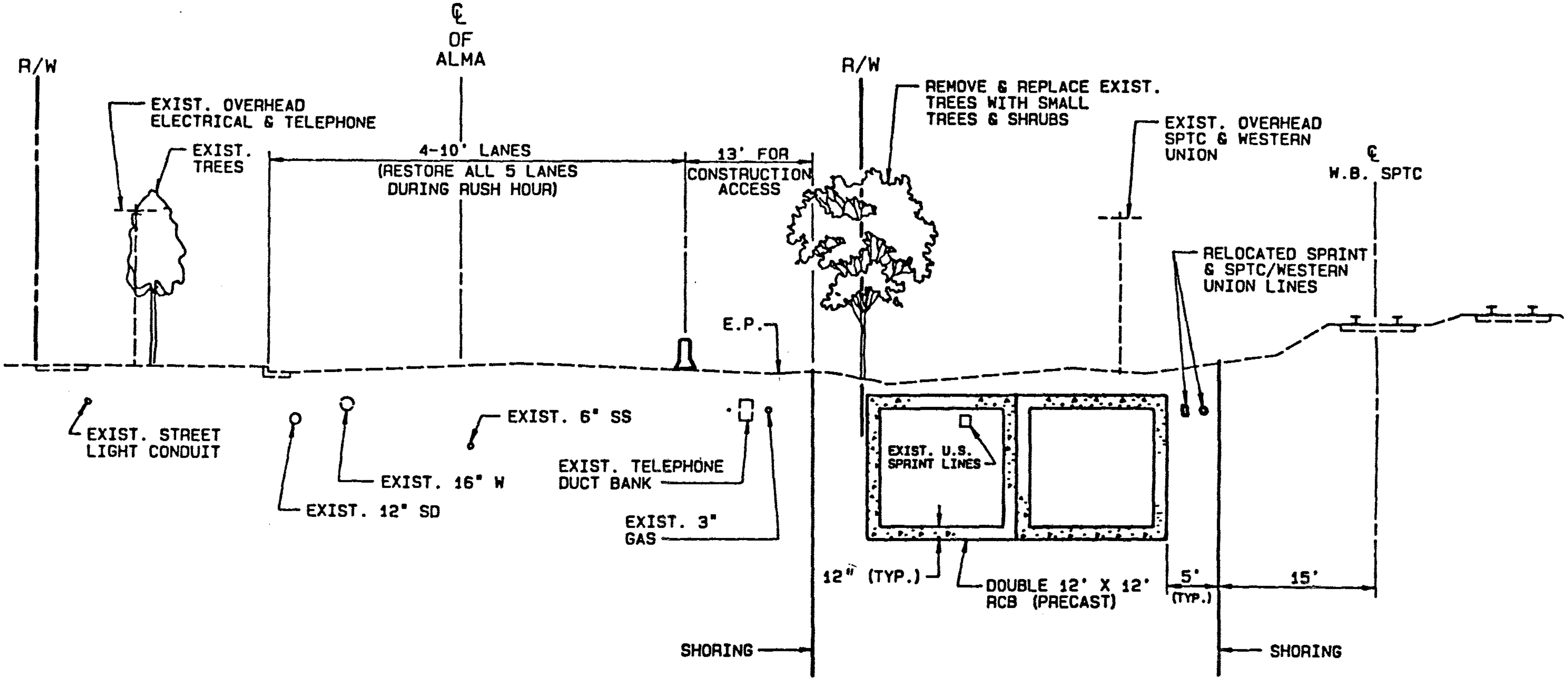

℄ OF ALMA
R/W
R/W
EXIST. OVERHEAD ELECTRICAL & TELEPHONE
EXIST. TREES
4-10' LANES (RESTORE ALL 5 LANES DURING RUSH HOUR)
13' FOR CONSTRUCTION ACCESS
REMOVE & REPLACE EXIST. TREES WITH SMALL TREES & SHRUBS
EXIST. OVERHEAD SPTC & WESTERN UNION
℄ W.B. SPTC
RELOCATED SPRINT & SPTC/WESTERN UNION LINES
E.P.
EXIST. STREET LIGHT CONDUIT
EXIST. 12" SD
EXIST. 16" W
EXIST. 6" SS
EXIST. TELEPHONE DUCT BANK
EXIST. 3" GAS
EXIST. U.S. SPRINT LINES
12" (TYP.)
DOUBLE 12' X 12' RCB (PRECAST)
5' (TYP.)
15'
SHORING
SHORING

**FIGURE 10**

TYPICAL SECTION - ALMA STREET
(UPPER REACH)

Pedestrian and bicycle traffic on Charleston Road would be significantly impacted during the sidewalk re-construction.

To permit construction of the 20′ x 9.5′ box culvert on Charleston Road, traffic on Charleston Road would have to be constricted to 1 lane with flagmen during 9:00 a.m. to 4:00 p.m. (2 lanes at other times). Even if precast box sections are used, this will last a long time. This is a significant impact to those who access the schools on Charleston Road and who commute on it. This would also impact bicycle traffic on the west side of Charleston Road.

Even if precast box sections are used on Charleston Road, vehicle access to driveways would be interrupted for several days at each residence. Emergency access to homes on Charleston Road, and the surrounding neighborhoods, would be degraded also.

The downstream half of the new Charleston Road bridge would have to be rebuilt to accommodate a confluence structure, with significant traffic impacts.

A portion of the RCB would have to be installed within the Palo Alto Senior Housing Project property, requiring removal and replacement of existing landscaping and walkways (an easement would be required).

A 22" PG&E gas line on Charleston Road would have to be relocated at the confluence with Adobe Creek.

The residents along Alma Street and Charleston Road would be exposed to noise, dust, and air pollution during construction.

**Long Term Impacts**

Long term impacts would be minimal - there would be no exposed channel or facilities. The long term impacts would include:

It would take many years for existing mature trees on the eastern side of Charleston Road to regain their current size after removal and replacement.

Any trees and shrubs planted on Alma Street to replace existing trees would be very close to the proposed double RCB. To prevent damage to the culvert, vegetation with less extensive root systems would have to be planted. It is doubtful that trees which grow to the existing size would be allowed.

Future repair or replacement of utilities placed under the sidewalk on the eastern side of Charleston Road would have a greater impact on the adjacent homes.

The District would have to place the box culvert under portions of the Palo Alto Senior Housing Project property and the property on the southeast corner of Alma St. and Charleston Road. Trees could not be re-planted over the culvert.

## Costs

Costs for this alternative would include right of way, shoring, installation of the box culvert, utility relocation, and the crossing of Alma Street.

The total cost of this alternative is $12,000,000.

## Conclusion

This project's environmental impacts are favorable for the existing Adobe Creek channel between Alma Street and Charleston Road. However, the high cost and the significant construction impacts along the culvert alignment combine to make this alternative not feasible.

# UPSTREAM STORAGE ANALYSIS

Four reservoir sites have been identified through reconnaissance using the County of Santa Clara 1" = 500′ aerials and planimetrics and the USGS 1" = 1000′ Palo Alto and Mountain View contour maps of the Adobe Creek watershed. No other sites were located that appeared to be feasible.

## Site I. Hidden Villa (Duvenek Ranch)

A dam site on Adobe Creek is located just above Murietta Lane on Moody Road (see contour map, Figure 11, with reservoir area shown).

At this location, the Adobe Creek hydrograph at point 1 shows a maximum flow of 1600 cfs and a total storm volume of 1212 acre-feet (see Appendix 3 for hydrograph).

### Storage Capacity

If we retain all the flow during a 1% flood, the flow downstream of Alma St. is:

3100 cfs (design flow at Alma St., refer to Adobe Creek Hydrology Report, Bibliography, Ref. #1)

- 1600 cfs (max. flow at Hidden Villa)
= 1500 cfs

According to the Adobe Creek Hydraulic Capacity Report (Bibliography, Ref. #2), the channel capacity between Alma Street and Charleston Road is 1100 cfs. With adequate freeboard, the acceptable flow in this channel is 700 cfs. Therefore, floodwalls would still be required between Alma Street and Charleston Road, and also the replacement of the Southern Pacific Transportation Co. (SPTC) culvert. The Alma Street bridge would be adequate to convey this flow.

The reservoir storage volume needed at this site is 2424 acre-feet.

### Site Size

The site would require approximately 70 acres of right of way and a dam would have to be approximately 90 feet high.

### Operation

This is the minimum feasible reservoir volume. Detailed reservoir operation studies may increase the volume required.

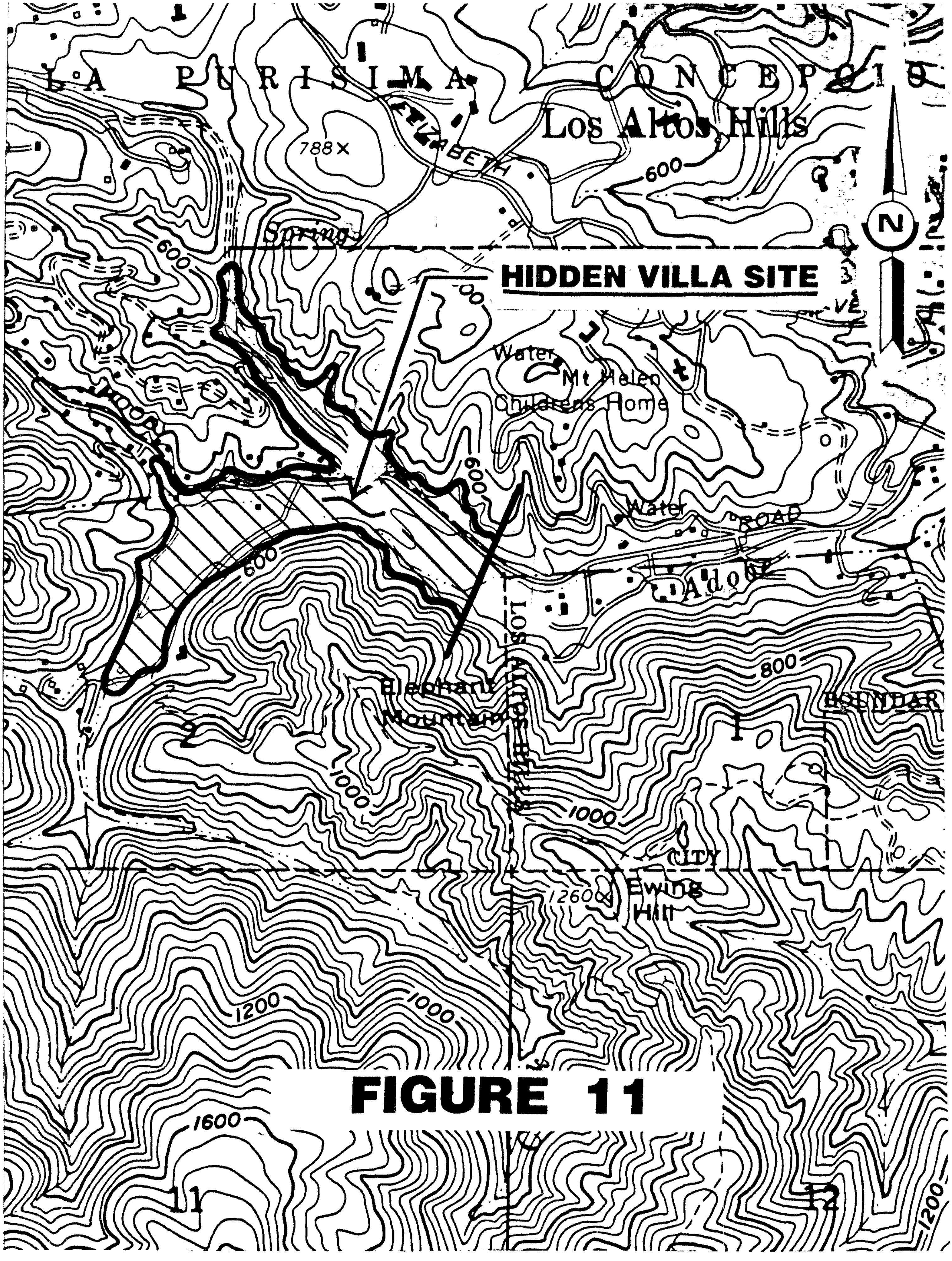

LA PURISIMA CONCEPCION
Los Altos Hills
788 X
ELIZABETH
600
Spring
HIDDEN VILLA SITE
N
Water
Mt Helen
Childrens Home
ROAD
Water
ROAD
600
Adobe
LOS ALTOS HILLS
800
Elephant
Mountain
BOUNDARY
1
2
1000
1000
CITY
2600 X
Ewing
Hill
1200
1000
1600
11
12
1200

FIGURE 11

## Impacts

### Construction Impacts

Noise, dust, and air pollution at the dam site and on Adobe Creek at the SPTC culvert and between Alma St. and Charleston Road.

Blasting for the dam foundations.

Traffic detours or stoppages due to relocation of Moody Road out of the inundated area, and increased truck traffic beyond the ordinary to the dam site.

Degradation of emergency services to Moody Road area due to Moody Road relocation.

Increased turbidity in Adobe Creek below dam site.

Possible removal and replacement of existing mature trees along several hundred feet of Alma Street for shoofly construction on the SPTC culvert replacement.

Construction traffic into Adobe Creek from Alma Street and Charleston Road, to work on the floodwalls and culvert replacement, which would impact traffic on Alma Street and Charleston Road.

Temporary removal and replacement of existing backyard fences between Alma Street and Charleston Road might be necessary for floodwall installation. Some backyard vegetation would also be affected.

The footbridge between Duncan Place and Creekside Way would be out of service for several months during floodwall installation.

### Long Term Impacts

3000′ of Moody Road and 1000′ of Moody Court (and utilities) would be relocated.

A minimum of 7 homeowners would have to be relocated, with the homes removed.

Hidden Villa and the current Los Altos Hills open space area would suffer flooding frequently.

Floodwalls several feet high between Alma Street and Charleston Road and SPTC culvert replacement would visually impact the homeowners.

### Cost

Right of way cost for this alternative is approximately $19,000,000. Construction costs would include: relocation of Moody Road and Moody Court and utilities 100 feet up the side of the canyon; construction of a dam 90 feet high; floodwalls between Alma Street and Charleston Road; and the SPTC culvert replacement.

The total cost for this site would be $35,000,000 to $40,000,000.

### Conclusion

The high cost, major environmental impacts, and impractical operational scenario combine to rule out this alternative.

## Site II. Foothill College

For this alternative, Highway 280 is assumed to acts as a dam on Adobe Creek at Foothill College (see contour map, Figure 13).

At this location, the combined Adobe Creek hydrograph shows a maximum flow of 2002 cfs (see Appendix 3 for hydrograph labeled "point 2").

### Storage Capacity and Site Size

The entire site would need to be excavated to EL. 280′ to the limits of the El. 320′ contour (this is very optimistic and requires high retaining walls). From the contour map shown in Figure 13, the available storage area covers 44 acres.

This would require the complete removal and relocation of the football and baseball fields and the eastern parking lots.

The available storage volume is 840 acre-feet.

The flow that would have to be retained from the peak of 2002 cfs would be:

$$\begin{array}{rl} & 3100 \text{ cfs (1\% design flow @ Alma)} \\ - & \underline{1300} \text{ cfs (capacity of SPTC culvert)} \\ & 1800 \text{ cfs.} \end{array}$$

Thus, 2002 cfs - 1800 cfs = 202 cfs is the allowed outflow.

The total storage capacity needed here, from the hydrograph, would be 2280 acre-feet.

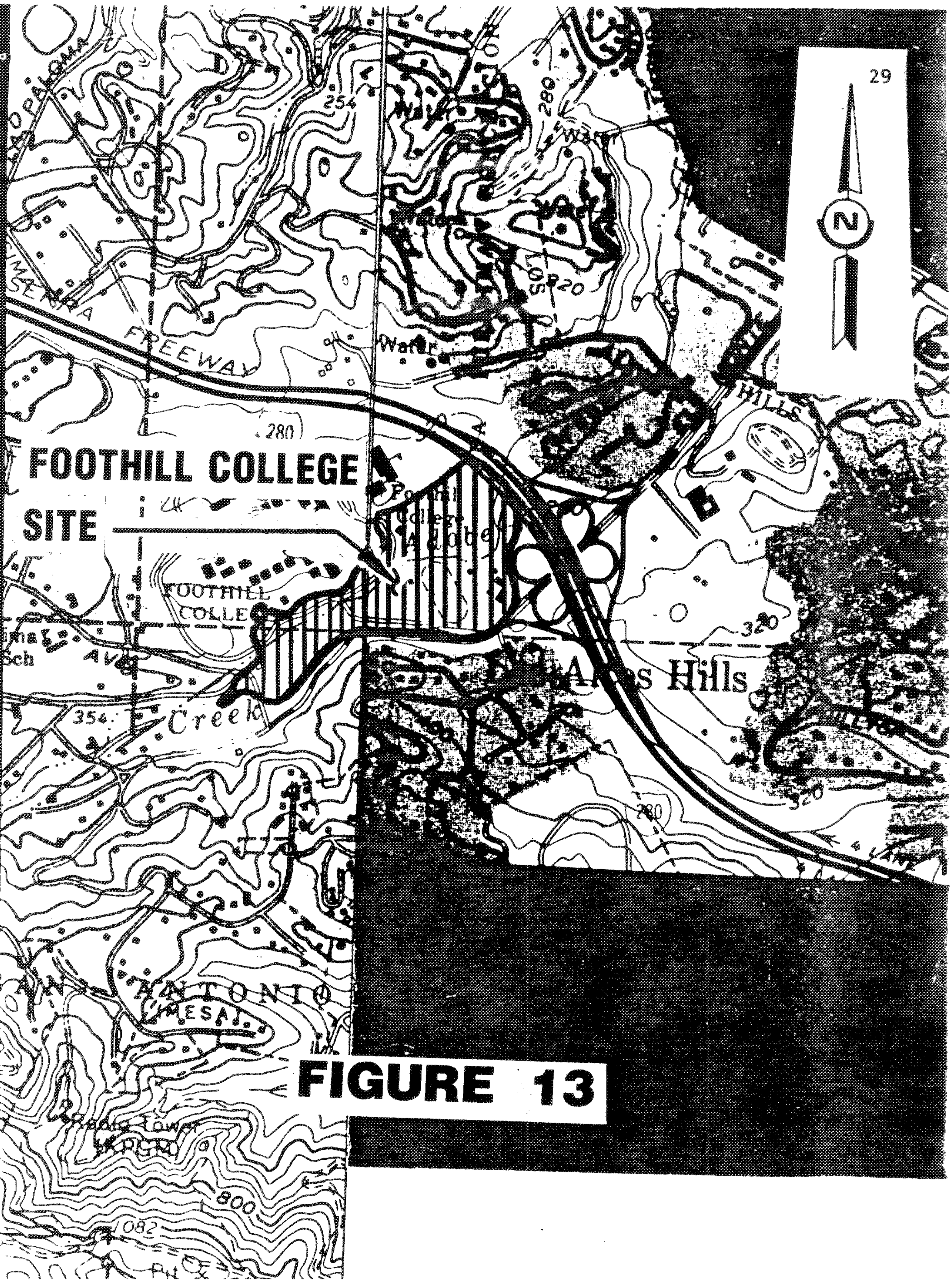

FOOTHILL COLLEGE SITE
N
FREEWAY
Water
280
254
320
Foothill College Adobe
FOOTHILL COLLEGE
AVE
Los Altos Hills
Creek
354
HILLS
4 LANE
ANTONIO
MESA
Radio Tower
800
1082

FIGURE 13

This site is not adequate for our goal of reducing the flow to 1300 cfs at Alma Street due to inadequate storage capacity (2280 acre-feet required vs. 840 acre-feet available with the assumed configuration). Another alternative would be to provide much more extensive flood control measures downstream, including replacement of the SPTC culvert and partial channel replacement with floodwalls between Alma Street and Charleston Road.

## Impacts

### Construction Impacts

Noise, dust, and air pollution at the reservoir site and between Alma Street and Charleston Road due to the installation of floodwalls.

Assuming that the volume of excavation is one third the storage volume, 450,000 yd^3 of soil and would have to be removed. This would require approximately 30,000 trips of 15-yard dump trucks through the area, in addition to the many other vehicle trips for construction.

Blasting to remove rock.

Interruptions in service of Foothill College utilities due to relocations.

Increased turbidity in Adobe Creek below the reservoir site.

Construction traffic into Adobe Creek from Alma Street and Charleston Road (to work on the floodwalls) would impact traffic on Alma Street and Charleston Road.

Temporary removal and replacement of fences between Alma Street and Charleston Road might be necessary for floodwall installation. Some backyard vegetation might also be affected.

The footbridge between Duncan Place and Creekside Way would be out of service for several months during floodwall installation.

### Long Term Impacts

Removal of the baseball and football fields and track and the eastern parking lots would severely impact the operation of Foothill College. If they were re-installed within the new reservoir, they would be subject to more frequent flooding (since we would have to throttle the Highway 280 culvert to 1300 cfs versus it's current capacity of 1800 cfs).

Floodwalls several feet high between Alma Street and Charleston Road would visually impact the homeowners there.

A concrete retaining wall at Foothill College would have a visual impact.

## Cost

Right of way cost for this alternative is approximately $25,000,000, not including damages for the loss of the baseball and football field and eastern parking lots. Costs for the reservoir would include excavation and disposal of approximately 450,000 yd^3 of rock and soil, and the construction of a retaining wall approximately 2000' long with a possible height of 40'. There would also be added costs for the floodwalls between Alma Street and Charleston Road.

The total cost for this alternative as described would be between $30,000,000 and $35,000,000.

Costs for this site, to provide adequate flood control protection, would have to include the replacement of the SPTC culvert and much of the channel between Alma Street and Charleston Road. To replace the SPTC culvert and much of the channel between Alma Street and Charleston Road, along with installing floodwalls, would cost $33,000,000 to $38,000,000.

## Conclusion

This alternative has a high cost and extreme environmental impacts to Foothill College. Floodwalls between Alma Street and Charleston Road would still be needed, along with replacement of the SPTC culvert and much of the channel between Alma Street and Charleston Road. The high cost and impacts to Foothill College make this alternative not feasible.

## Site III. Terman Junior High School

This site is between Arastadero Road and Adobe Creek immediately below the Alta Mesa Cemetery (see contour map, Figure 14).

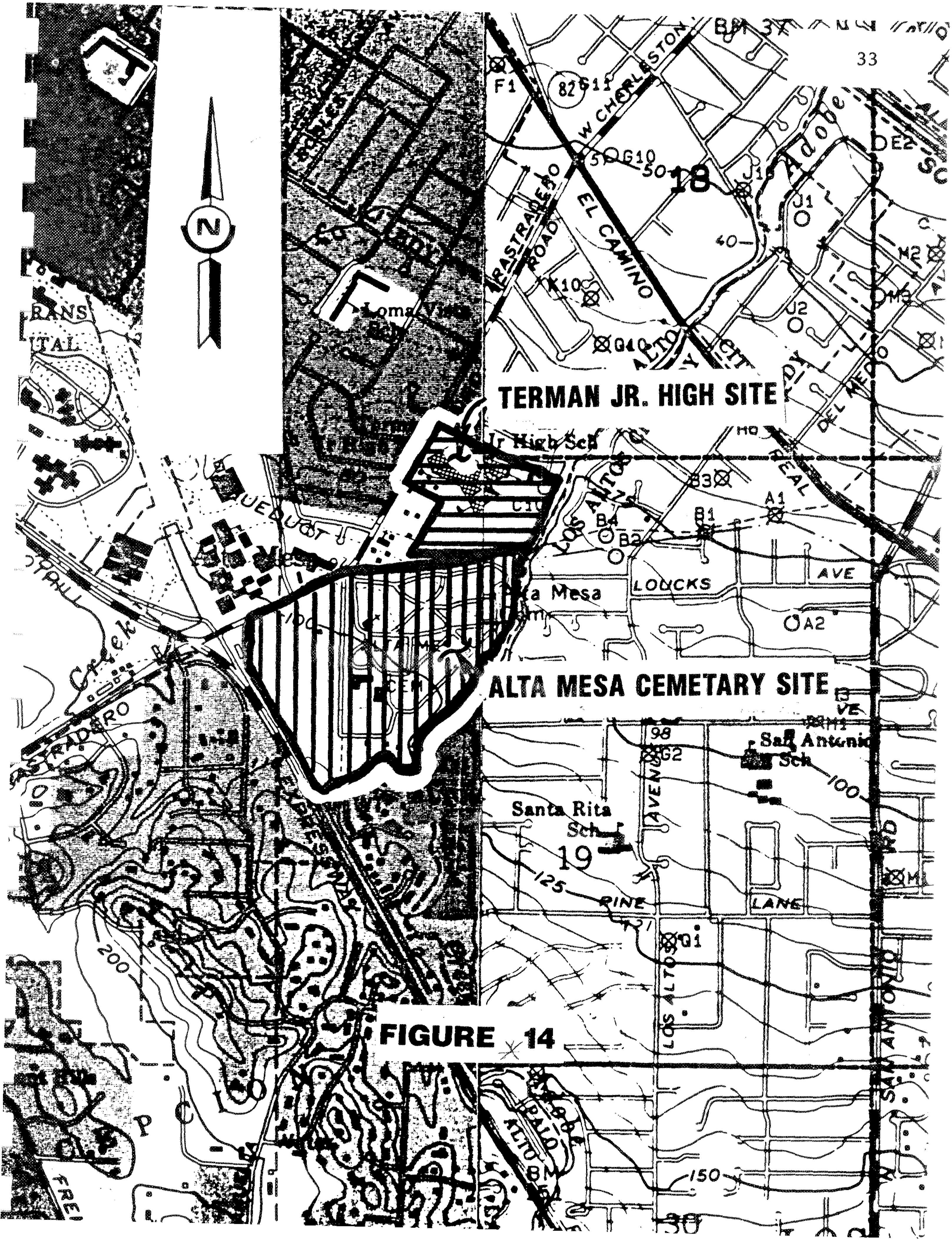

TERMAN JR. HIGH SITE
ALTA MESA CEMETARY SITE
W CHARLESTON
EL CAMINO REAL
ARASTRADERO ROAD
Adobe
DEL MEDIO
LOS ALTOS
LOUCKS AVE
Alta Mesa
Loma Vista Sch
Jr High Sch
San Antonio Sch
Santa Rita Sch
PINE LANE
LOS ALTOS AVENUE
SAN ANTONIO RD
PALO ALTO
18
19
30
N

**FIGURE 14**

This location is approximately halfway between the Adobe Creek hydrograph points 3 and 4. The average of the two hydrographs has been used to produce an average hydrograph for this location.

The average hydrograph shows a maximum flow of 2843 cfs (see attached hydrographs, Appendix 3, for points 3 & 4 and the average hydrograph).

**Storage Capacity and Site Size**

It is assumed that the SPTC culvert will not be replaced. This culvert has a capacity of 1300 cfs. Floodwalls several feet high will still have to be installed between Alma Street and Charleston Road.

The reservoir must retain all flow above 1300 cfs. From the hydrograph, this is a peak of 1543 cfs retained, with a required storage capacity of 255 acre-feet.

This site is approximately 21.7 acres, if we can acquire the total site including the street that accesses it.

**Reservoir Configuration**

If this whole site is used for storage, depth of storage would be: D = 255 acre-feet/21.7 acre = 11.7 feet deep.

From the District's 1972 topographic survey of the creek, the grades at the creek were:

At the upstream end of the site, the channel bottom was at El. 62' and the top of bank at El. 81'.

At the downstream end of the site, the channel bottom was at El. 60' and the top of bank at El. 75'.

It is assumed that 10 feet on the perimeter and 40 feet along the existing channel for the spillway is not available for storage. The available area would be 20.5 acre. The depth of storage would then be:

D = 255 acre-feet/20.5 acre = 12.4 feet deep (actual depth to existing channel bottom is 15' minimum).

It is assumed that the reservoir is excavated at 3:1 sideslopes with the setbacks defined above. A storage capacity of 262 acre-feet at a depth of 14' is obtained.

Freeboard on the downstream side of the reservoir requires a floodwall 6 foot high.

## Impacts

### Construction Impacts

Noise, dust, and air pollution at the reservoir site and on Adobe Creek between Alma St. and Charleston Road.

Increased turbidity in Adobe Creek below dam site.

Removal of some 440,000 cubic yards of soil resulting in approximately 29,000 15-yard dump truck trips through the neighborhood, along with other construction related traffic.

Asbestos was used in the construction of most schools in the past. The demolition of these buildings might require the removal of asbestos (this would be the responsibility of the seller -ie, the school district).

Construction traffic into Adobe Creek from Alma Street and Charleston Road, to work on the floodwalls, would impact traffic on Alma Street and Charleston Road.

Temporary removal and replacement of existing backyard fences between Alma Street and Charleston Road might be necessary for floodwall installation. Some backyard vegetation would also be affected.

The footbridge between Duncan Place and Creekside Way would be out of service for several months during floodwall installation.

### Long Term Impacts

The removal of the existing junior high school, which is in use as a City of Palo Alto library, Jewish Community Center, low income housing, and a neighborhood park. Relocating or removing these facilities from the neighborhood would be a major impact to the area and to the whole City of Palo Alto.

A floodwall (6 foot high maximum) on the lower sides of the reservoir would impact the homeowners. Floodwalls several feet high between Alma Street and Charleston Road would also visually impact the homeowners there.

Approximately 500 feet of riparian habitat in the existing channel would be eliminated by the installation of a side flow spillway.

There would be sediment deposition within the reservoir. This would require periodic removal of the sediment, and thereby any vegetation, by the District's maintenance forces.

This would visually impact the reservoir itself, which would be visible for much of its perimeter.

### Cost

The reservoir would cost about $4,500,000 to construct. The right of way would cost another $20,000,000, without the cost of buying out the leases of the tenants and relocating the low-income housing homeowners. There would also be additional costs from the floodwalls installed between Alma Street and Charleston Road.

The total cost for this site would be approximately $30,000,000.

### Conclusion

This alternative has a high cost and major environmental impacts to the neighborhood. Floodwalls between Charleston Road and Alma Street are still needed. These factors render it not feasible.

## Site IV. **Alta Mesa Cemetery**

This site is between Arastadero Road and Adobe Creek next to the Foothill Expressway (see contour map, Figure 14).

The storage capacity needed here is the same as at Terman Junior High School immediately downstream - 255 acre-feet. The hydraulics and the configuration of this site would be similar to site III at Terman Junior High school. The greater area (approximately 70 acres) would decrease the required depth of storage, eliminating any floodwalls at the reservoir.

### Impacts

### Construction Impacts

Noise, dust, and air pollution at the reservoir site.

Increased turbidity in Adobe Creek below reservoir site.

Removal of some 440,000 cubic yards of soil resulting in approximately 29,000 15-yard dump truck trips through the neighborhood, along with other construction related traffic.

Construction traffic into Adobe Creek from Alma Street and Charleston Road, to work on the floodwalls, would impact traffic on Alma Street and Charleston Road.

Temporary removal and replacement of existing backyard fences between Alma Street and Charleston Road might be necessary for floodwall installation. Some backyard vegetation would also be affected.

The footbridge between Duncan Place and Creekside Way would be out of service for several months during floodwall installation.

**Long Term Impacts**

Relocating all of the burial sites. This is an extreme social impact to the families of those buried there. Future burials would have to be at another location.

Approximately 2500 feet of riparian habitat in the existing channel would be eliminated by the installation of the reservoir and the side flow spillway.

There would be sediment deposition within the reservoir. This would require periodic removal of the sediment, and thereby any vegetation, by the District's maintenance forces. This would visually impact the reservoir itself, which would be visible for most of its perimeter.

Floodwalls several feet high between Alma Street and Charleston Road would visually impact the homeowners there.

**Cost**

The right of way would cost approximately $35,000,000. The reservoir would cost somewhat more than the $4,500,000 cost of Terman Jr. High School, with the additional cost of relocating all the burial sites. Relocation costs would also include notifying all the heirs.

The total cost would be approximately $40,000,000.

**Conclusion.**

This is not an acceptable alternative due to the social and environmental impacts and the high cost.

## V. Combination of Sites

A combination of sites could be used to reduce the costs and impacts at individual sites. However, the cumulative costs and impacts would exceed those of the sites taken individually. A combination of these sites is not a feasible alternative.

## VI. Summary

The high costs (ranging from $30 million to $40 million) and major environmental impacts make these upstream storage alternatives not feasible, in comparison to the preferred alternative of channel replacement between El Camino Real and Charleston Road and culvert modification at Alma Street and replacement at SPTC.

# ADOBE CREEK DIVERSION ALTERNATIVE

This alternative consists of diverting enough flow from Adobe Creek to Matadero Creek to avoid major flood control work on Adobe Creek between Alma Street and Charleston Road.

## Background

The 1985 Adobe Creek Engineer's Report (Bibliography, Ref. #3) examined this alternative and concluded that it was not feasible. This was because of: the excessive cost; doubt as to whether Matadero Creek could be designed to carry the large additional flow because of limited right of way and downstream hydraulic constraints; long term environmental impacts; construction impacts; and the need to replace the existing culverts at SPTC, Middlefield Road, and Louis Road.

The 1988 Matadero Creek Engineer's Report (Bibliography, Ref. 4) proposed the diversion of 600 cfs from Barron Creek to Matadero Creek. This plan required the Matadero Creek channel to be upgraded to carry both the Matadero Creek 1% design flow and the 600 cfs flow diverted from Barron Creek. The diversion was selected as the preferred alternative because of it's moderate construction impacts, moderate long term impacts, and the increased cost-effectiveness of the combined Matadero Creek-Barron Creek flood control measures. It is feasible because the flow to be diverted from Barron Creek is small (600 cfs) relative to the design flow in Matadero Creek of 2900 cfs.

## Proposed Adobe Creek Diversion Alignment

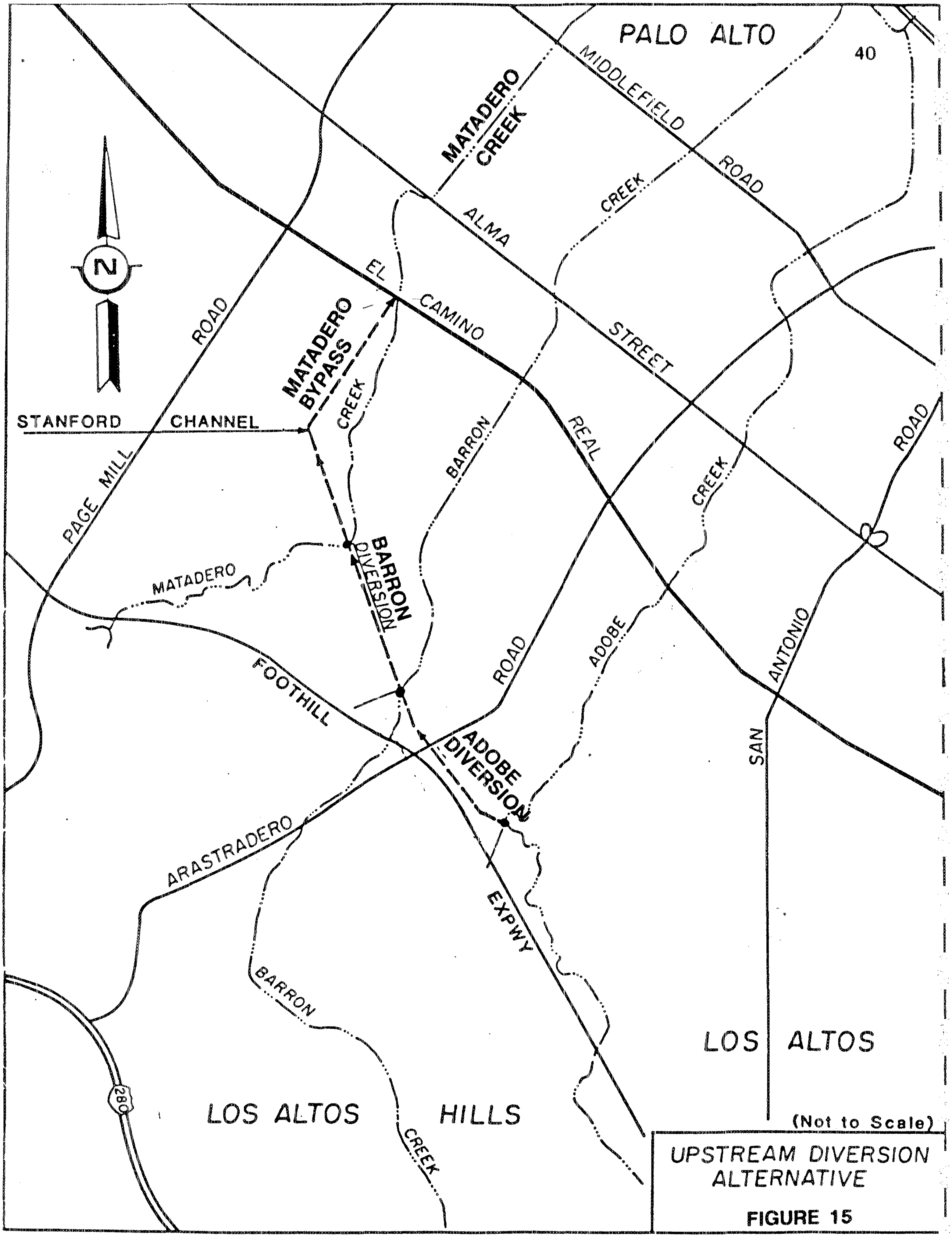
The excess flow from Adobe Creek would be diverted at the upstream end of the Alta Mesa Cemetery. The diversion would pass through the southern edge of the Alta Mesa Cemetery, cross Arastadero Road, and follow the SPTC right of way (next to Gunn High School) to the Barron Creek Sediment Basin. From here, the diverted flow would follow the Barron Diversion and Matadero Bypass to Matadero Creek at El Camino Real. The flow below El Camino Real is contained within Matadero Creek until it reaches the Palo Alto Flood Basin (PAFB).

See Figure 15 for the alignment.

## Summary

This alternative has significant construction and long term impacts. The cost is also very high - $49,100,000. For these reasons, this is not a feasible alternative.

The remainder of this report contains a more detailed review of these factors.



(Not to Scale)

UPSTREAM DIVERSION ALTERNATIVE

**FIGURE 15**

### Diversion - Flow Amount

The design flow in Adobe Creek between Alma Street and Charleston Road is 3100 cfs ( Adobe Creek Hydrology Report, Bibliography, Ref. #1). The Adobe Creek capacity in this reach is 1100 cfs (refer to the Adobe Creek Capacity Analysis, Bibliography, Ref. #2).

With minimal modifications, such as low floodwalls, it is assumed that Adobe Creek between Alma Street and Charleston Road could carry 1185 cfs with freeboard (Appendix 2).

Since 257 cfs of runoff enters the channel between Alma Street and the point of diversion, the amount of flow allowed to remain in Adobe Creek immediately downstream of the Diversion is:

1185 cfs - 257 cfs = 928 cfs.

Since the peak flow at the diversion (see hydrograph, Appendix 3) is 2843 cfs, the amount to be diverted to Matadero Creek is:

2843 cfs - 928 cfs = 1915 cfs.

### Channel Reaches

The detailed analysis of this alternative is broken up into convenient channel reaches for study:

| | |
|---|---|
| Matadero Creek | - Palo Alto Flood Basin to Ross Road |
| | - Ross Road to Alma Street |
| | - Alma Street to El Camino Real |
| | - Upstream of El Camino Real |
| Matadero Bypass | - El Camino Real to Matadero Creek |
| Barron Diversion | - Matadero Creek to Barron Sediment Basin |
| Adobe Diversion | - Barron Sediment Basin to Adobe Creek |

### A. Matadero Creek - Palo Alto Flood Basin to Ross Road

### Configuration

The channel between Highway 101 and Ross Road is under construction and includes installing floodwalls and replacing culverts. The floodwalls are a maximum of 4.5' high.

The channel would have to be enlarged to carry the additional flow from Adobe Creek. The channel between Highway 101 and the PAFB does not require modifications.

Upstream of Highway 101 modifications consist of widening all the culverts to the width of the right of way, and of removing the existing earth and concrete trapezoidal channel and replacing it with a concrete U-frame channel.

It is assumed that the channel at Highway 101 could be modified. See Figure 16 for a typical channel section.

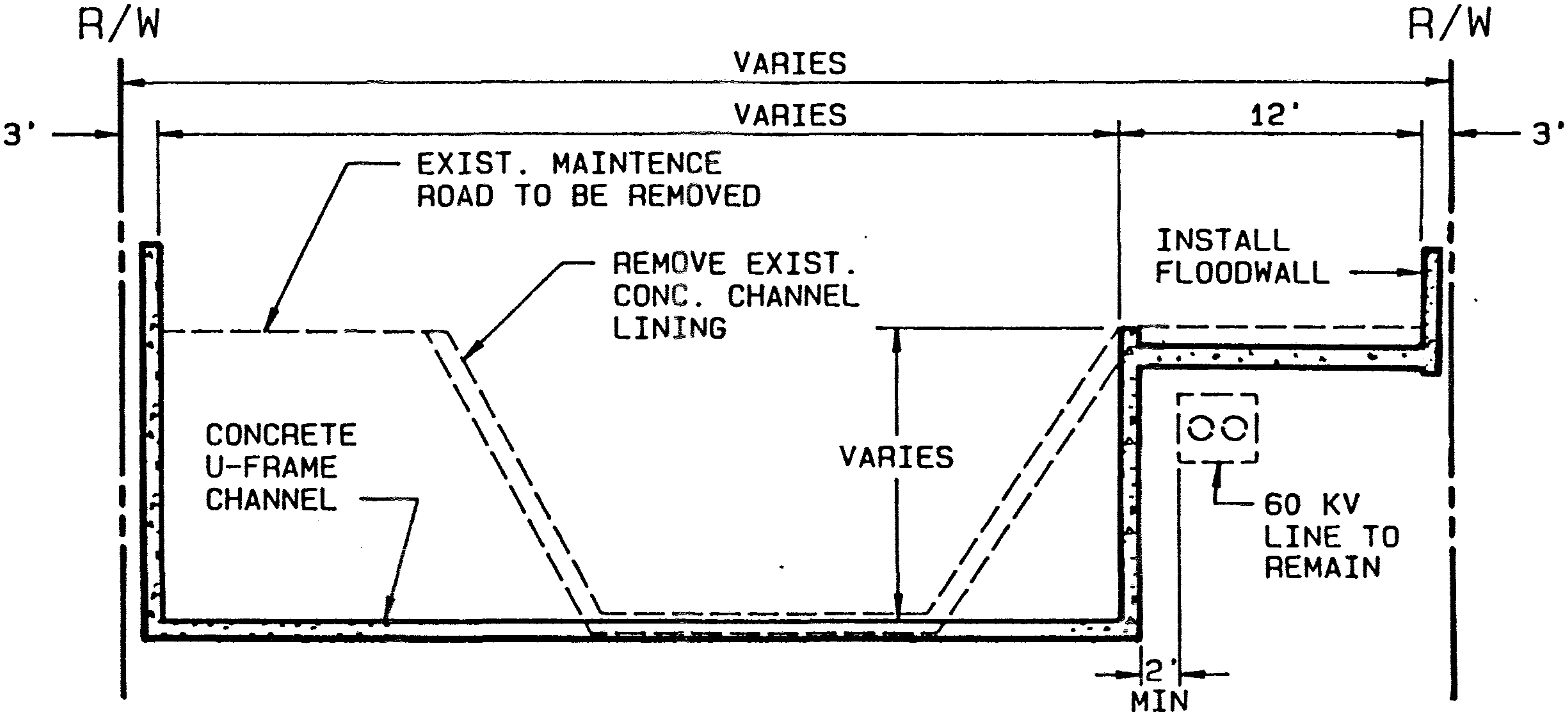


FIGURE 16

TYPICAL SECTION-BAYSHORE FWY TO GREER RD.

## Water Surface Profile

The maximum wall height is over 6 feet high upstream of the Louis Road bridge.

Further improvements in this water surface profile, and subsequent improvements upstream, would require relocation of the City of Palo 60 Kv line, or the sanitary sewer along Matadero Creek, or both. These relocations would cost millions of dollars.

## Impacts

### Construction Impacts

Noise, dust, and air pollution along the creek.

In order to minimize the wall heights, the existing channel would be removed and a U-frame channel installed. This U-frame channel would be designed as close to the right of way as possible - within 3′ of the right of way and existing structures.

Construction traffic into Matadero Creek from Louis Road, Greer Road, and Ross Road, to work on the earth and concrete channel removal and replacement and culvert modification and replacement, would impact traffic on these streets

Temporary removal and replacement of existing backyard fences between Highway 101 and Ross Road would be necessary for channel installation. Backyard vegetation would also be affected.

Vibrations due to pile driving, if used for shoring for the U-frame channel near the right of way, could damage structures and cause homeowners discomfort.

Numerous utility relocations, with possible temporary interruptions in service, would be necessary.

### Long Term Impacts

U-frame channel walls 6 feet above ground would have a visual impact on the neighborhoods.

The existing earth channel bottom between Highway 101 and Louis Road would be lost, degrading the habitat.

Many District access ramps and maintenance roads would be eliminated. District maintenance operation would become more costly and time consuming.

The proposed City of Palo Alto bike path under Highway 101 would be eliminated to maximize the channel capacity.

### Costs

Costs for this alternative between Highway 101 and Ross Road would include channel removal and replacement with a U-frame channel and replacement of the culverts at Louis Road, Greer Road, and Ross Road, along with the repair of any structural damages due to construction.

The total cost of this reach is $9,700,000.

## B. Matadero Creek - Ross Road to Alma Street

### Configuration

The flood control improvements in this reach, currently or soon to be under construction, consists of the installation of floodwalls, the removal and replacement of a section of channel, and the replacement of the existing culverts at Middlefield Road, Cowper Street, and Waverly Street. Several footbridges are also to be raised.

In order to accommodate the additional Adobe Creek flows, the channel and the culverts in this reach would need to be replaced, and the footbridges raised.

### Water Surface Profile

Due to the high wall heights on the lower reach of Matadero Creek, the substantial construction and long term impacts, and the cost, a water surface was not calculated for this reach. With the improvements proposed, the water surface profile and the wall heights would stay approximately the same as in the 1988 Matadero Creek Engineer's Report.

### Impacts

The construction and long term impacts would be similar to those of the reach of channel between Highway 101 and Ross Road.

### Costs

Costs for this alternative between Ross Road and Alma Street would include channel removal and replacement with a U-frame channel and replacement of the culverts at Middlefield Road, Cowper Street, and Waverly Street, along with the repair of any structural damages due to construction.

The total cost of this reach is approximately $8,700,000.

## C. Matadero Creek - Alma Street to El Camino Real

### Configuration

The 1988 Matadero Creek Engineer's Report proposed the replacement of the existing concrete trapezoidal channel with a 25' U-frame channel, and the replacement of the existing culverts at SPTC, Park Boulevard, and Lambert Street.

The proposed water surface in this reach of channel is within 6 inches of the soffit at Park Boulevard, as proposed in the Matadero Creek Engineer's Report. The additional flow would certainly increase the water surface by several feet, and put all the culverts into pressure flow. The existing channel and street grades at the culverts, and the available channel slopes, prevent further alterations in the channel here that will reduce the water surface.

The properties on both sides of Matadero Creek upstream and downstream of Park Avenue are zoned to change from commercial to residential within 10 years. This required development will probably need additional access across the channel in this vicinity. A floodwall of 4 or 5 feet would make that very difficult if not impossible.

Therefore, the proposal is for a 25' wide box culvert between Alma Street and El Camino Real.

### Water Surface Profile

With the additional flow from Adobe Creek, and the proposed box culvert, the channel would be in pressure flow between Alma Street and El Camino Real.

### Impacts

### Construction Impacts

Construction impacts would be similar to those for the downstream channel reaches.

### Long Term Impacts

Maintenance access would be eliminated in this reach, making maintenance much more costly and time consuming.

### Costs

Costs for this alternative between Alma Street and El

Camino Real would include channel removal and replacement with a box culvert, and replacement of the culverts at SPTC, Park Boulevard, and Lambert Street.

The total cost of this reach is approximately $5,800,000.

## D. Matadero Creek - Immediately Upstream of El Camino Real

### Configuration & Water Surface Profile

The 1988 Matadero Creek Engineer's Report proposed that this reach be left essentially unaltered; all excess flow from upstream is to be carried by the Matadero Bypass (the Matadero Bypass is a large box culvert which will carry excess flow around this reach of Matadero Creek).

With the reach from Alma Street to El Camino Real in a box culvert, under pressure flow, the water surface in the lower section of this reach would back up from the upper end of the El Camino box culvert.

In order to contain this increased water surface from the backwater effect, floodwalls would have to be installed. These floodwalls would have to be several feet high at a minimum, and extend upstream about 500 feet from El Camino.

### Impacts

### Construction Impacts

Some of the existing vegetation along this section of the creek would be removed; these include coast live oaks, valley oaks, and other native and non-native trees and shrubs.

There are existing driveway bridges and footbridges which would have to be raised. Access would be impacted.

Access to this reach, and construction traffic through it, could have a substantial impact on the vegetation in the reach.

Noise, dust, and air pollution along the creek.

### Long Term Impacts

The floodwalls would prevent the re-planting of the oak trees in the same places; it is possible that some could not be re-planted due to lack of space. Also, it would take many years for the oak trees to regain their pre-removal sizes.

The installation of floodwalls in this area would have a visual impact.

The raising or removal of driveway bridges and footbridges would impact access to these properties.

**Costs**

The costs to construct floodwalls would be approximately $200,000 (most of these costs are due to the raising or removal of driveway bridges and footbridges).

### E. Matadero Creek Bypass (El Camino Real to Matadero Creek)

**Amount of flow**

In the Matadero Creek Bypass, the peak flow from Adobe Creek of 1915 cfs would coincide with that of the peak Matadero and Barron Creek flows.

The flow in this reach would be:

  1915 cfs (Adobe Creek)
+ 1700 cfs (Barron + Matadero Creek, from the Engineer's Report)
= 3615 cfs.

**Configuration**

The 1988 Matadero Creek Engineer's Report proposed the installation of a 12' x 12' box culvert between El Camino Real and Matadero Creek.

The additional flow, coupled with the available invert and ground surface grades, would require a 23' x 12' box culvert. This would still provide adequate freeboard within the box culvert.

**Water Surface Profile**

The water surface within the bypass would be very similar to that in the Matadero Creek Engineer's Report.

**Impacts**

**Construction Impacts**

Noise, dust, and air pollution on Adobe Creek between El Camino and Matadero Creek.

Removal and replacement of much of the vegetation within Bol Park and behind Chimalus Dr.; this amount would be much greater than proposed in the 1988 Matadero Creek Engineer's Report.

Construction would be much closer to the homes on Chimalus Drive than was proposed in 1988, with increase in the impacts.

The wider box culvert would require greater excavation, which would require more construction traffic to and from the site.

The increased width, and thus room used for construction, might prevent the bike path downstream of Matadero Avenue from remaining open during construction. The bike path upstream of Matadero Avenue would have to be detoured during construction as the Engineer's Report indicated.

An increased right of way within the Varian parking lot could impact parking and parking lot traffic significantly.

Increased construction within the possible areas of soil and groundwater contamination could increase exposure of construction workers and property owners to toxic materials.

### Long Term Impacts

A wider box culvert would mean a wider area within Bol Park where certain species of vegetation could not be planted - ie, trees and plants with large, deep root systems could not be planted on top of or too near the wider box culvert.

Maintenance of utilities that pass below the box culvert would be more difficult.

Installation of future utilities at Matadero Avenue would be more difficult than with the narrower box culvert.

### Costs

Costs for this alternative between El Camino Real and Matadero Creek would include removal of the existing Stanford Channel, installation of a box culvert, the installation of a diversion structure at Matadero Creek, and the removal and replacement of the existing vegetation along the alignment.

The total cost of this reach is approximately $13,100,000.

## F. Barron Creek Diversion (Matadero Creek to Barron Sediment Basin)

### Amount of flow

In the Barron Creek Diversion, the flow would be:

```
  1915 cfs (Adobe Creek)
+  600 cfs (Barron Creek, from the
           Engineer's Report)
= 2515 cfs.
```

### Configuration

The 1988 Matadero Creek Engineer's Report proposed the installation of a 10' x 6' box culvert between Matadero Creek and the Barron Sediment Basin.

The additional flow, coupled with the available invert and ground surface grades, would require a 23' x 8' box culvert. This would still provide adequate freeboard within the box culvert.

### Water Surface Profile

The water surface within the bypass would be very similar to that in the Matadero Creek Engineer's Report.

### Impacts

### Construction Impacts

Noise, dust, and air pollution along the Barron Diversion.

The bike path would have to be detoured during construction as the Engineer's Report indicated.

Removal and replacement of much of the vegetation within Bol Park; this amount would be much greater than proposed within in the 1988 Matadero Creek Engineer's Report.

Increased construction within the possible areas of soil and groundwater contamination could increase exposure of construction workers and property owners to toxic materials.

### Long Term Impacts

A wider box culvert would mean a wider area within Bol Park where certain species of vegetation could not be planted - ie, trees and plants with large, deep root systems could not be planted on top of or too near the wider box culvert.

Maintenance of utilities that pass below the box culvert would be more difficult.

The wider box culvert would require greater excavation, which would require more construction traffic to and from the construction site.

**Costs**

Costs for this alternative between Matadero Creek and the Barron Sediment Basin would include installation of a box culvert, modification of the existing Barron Sediment Basin, and the removal and replacement of the existing vegetation along the alignment.

The total cost of this reach is approximately $4,300,000.

### G. Adobe Creek Diversion (Barron Sediment Basin to Adobe Creek)

**Amount of flow**

The flow in this reach would be 1915 cfs, as determined under the section of this report titled "Flow Rate at the Diversion".

**Configuration & Water Surface Profile**

We assumed the installation of a 13′ x 12′ box culvert between Adobe Creek and the Barron Sediment Basin.

This would provide adequate freeboard within the box culvert at 1915 cfs.

**Impacts**

**Construction Impacts**

Noise, dust, and air pollution along the Adobe Creek Diversion. These impacts would be especially a problem for the students at Gunn High School.

The bike path between Arastadero Road and the Barron Sediment Basin would have to be detoured during construction.

Removal and replacement of much of the vegetation within Bol Park.

Increased construction within the possible areas of soil and groundwater contamination could increase exposure of construction workers, property owners, and the students and staff at Gunn High School to toxic materials.

The construction of the Adobe Creek diversion structure would impact Adobe Creek vegetation and wildlife, and possibly increase Adobe Creek turbidity.

Traffic on Miranda Avenue may be impacted during installation of the box culvert within the Alta Mesa Cemetery. The culvert crossing of Arastadero Road could also impact traffic.

### Long Term Impacts

Approximately 1500′ of the box culvert would be within the Alta Mesa Cemetery next to Miranda Avenue. Any burial sites within this construction corridor would have to be relocated.

### Costs

Costs for this alternative between the Barron Sediment Basin and Adobe Creek would include installation of a box culvert, crossing of Arastadero Road, right of way at the Alta Mesa Cemetery, and the relocation of any burial sites affected.

The total cost of this reach is $7,300,000.

## H. Adobe Creek (Charleston Road to Alma Street)

### Flow Amount

As indicated in the section of this report titled "Adobe Creek Channel Capacity", the 1% design flow in this reach will be 1185 cfs.

### Configuration & Water Surface

Floodwalls several feet high would be installed between Alma Street and Charleston Road.

The water surface would be below the top of the existing bank for much of this channel section.

### Impacts

### Construction Impacts

Noise, dust, and air pollution on Adobe Creek between Alma St. and Charleston Road.

Construction traffic into Adobe Creek from Alma Street and Charleston Road, to work on the floodwalls, would impact traffic on Alma Street and Charleston Road.

Temporary removal and replacement of existing backyard fences between Alma Street and Charleston Road might be necessary for floodwall installation. Some backyard vegetation would also be affected.

The footbridge between Duncan Place and Creekside Way would be out of service for several months during floodwall installation.

The installation of floodwall foundations (ie, drilled piles) next to pools and other structures might damage them.

**Long Term Impacts**

Floodwalls several feet high between Alma Street and Charleston Road would visually impact the homeowners there.

**Costs**

Costs for this alternative between Alma Street and Charleston Road would include installation of floodwalls, and the removal and replacement of existing vegetation and fences along the channel.

The total cost of this reach is less than $150,000.

**Conclusion**

The total cost of the work proposed in the Matadero Creek Engineer's Report is $21,000,000. The total cost of this alternative is $49,100,000.

Floodwalls are still required between Alma Street and Charleston Road. The other impacts mentioned here on Matadero Creek are similar to those for the 17'/20' U-frame alternative on Adobe Creek, except much more extensive.

Due to the high cost and environmental impacts, this is not a feasible alternative.

# BIBLIOGRAPHY

(1) A. Saah, SCVWD, Adobe Creek Hydrology, April, 1989.

(2) D. Hook, SCVWD, Adobe Creek Hydraulic Capacity Analysis, May, 1989.

(3) K. Whitman, SCVWD, Adobe Creek Planning Study and Engineer's Report, June, 1985.

(4) K. Whitman, SCVWD, Matadero Creek Planning Study and Engineer's Report, April, 1988.

## ADOBE CREEK - PHASE IV

## CHARLESTON RD TO MILLER AVE.

## 17 & 20 FOOT U-FRAME CHANNEL REPLACEMENT COST ESTIMATE

| ITEM NO. | ITEM | QUANTITY | UNIT PRICE | COST |
|---|---|---|---|---|
| 1 | MOBILIZATION | L.S. | L.S. | $292,903 |
| 2 | CLEARING & GRUBBING | L.S. | L.S. | $50,000 |
| 3 | CONCRETE REMOVAL | 2916 CY | 100 | $291,600 |
| 4 | EMBANKMENT / FILL | 590 CY | 15 | $8,850 |
| 5 | EXCAVATION | 5909 CY | 7 | $41,363 |
| 6 | CONCRETE STRUCTURES (20 & 17 FT U-FRAME) | 6361 CY | 450 | $2,862,450 |
| 7 | SHORING | 3823 SY | 135 | $516,105 |
| 8 | MONITORING (SOIL STABILITY) | L.S. | L.S | $100,000 |
| 9 | UTILITIES & STORM DRAIN FACILITIES | L.S. | L.S. | $35,000 |
| 10 | ADMINISTRATION | L.S. | L.S. | $702,966 |
| | | | SUBTOTAL | $4,901,237 |
| | | | ALMA ST & SPTC BOX CULVERT | $857,040 |
| | | | ESTIMATED PROJECT COST | $5,758,277 |

```
          **********          ***********          **********          **********

                                        HYDROGRAPH BALANCE
                         ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME
                             1       88        0        0        0        0        0

     BALANCE DESIRED         1     1558.     4.48    28674.       0        0.       0        0.       0        0
   BALANCE RESULTS                 1558.             28674.                0.                0.                0.

ER OF ITERATIONS=  2

                                  END-OF-PERIOD FLOWS AT       1
                                        SUM=     29325.
          7.        26.        56.        96.       124.       139.       182.       250.       323.       399.
        446.       466.       470.       459.       462.       477.       489.       498.       497.       488.
        480.       474.       477.       488.       501.       515.       570.       659.       694.       680.
        718.       803.       868.       912.      1071.      1329.      1558.      1213.      1076.       970.
        875.       786.       711.       646.       601.       571.       542.       511.       439.       330.
        244.       181.       133.        97.        70.        51.        37.        27.        19.        14.
         10.         7.         4.         3.         1.         1.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.

                              PEAK    6-HOUR    24-HOUR    72-HOUR    TOTAL VOLUME
                     CFS     1558.     1015.       597.       293.          29325.
                  INCHES               2.22        5.23       5.35           5.35
                   AC-FT                504.       1185.      1212.           1212.
```

```
**********          **********          **********          **********          **********

                                  COMBINE HYDROGRAPHS

          ADOBE   CREEK   U/S   PURISSIMA CREEK    POINT 2

                    ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                        2       2       0       0       0       0       1

                               SUM OF 2 HYDROGRAPHS AT      2
    11.       29.       70.      125.      167.      188.      234.      321.      420.      527.
   600.      617.      617.      596.      593.      613.      633.      648.      647.      630.
   616.      607.      611.      627.      646.      665.      734.      858.      915.      889.
   928.     1052.     1150.     1204.     1402.     1892.     2002.     1668.     1342.     1246.
  1087.      988.      881.      804.      746.      714.      681.      644.      555.      407.
   304.      215.      156.      113.       83.       59.       43.       31.       22.       16.
    11.        8.        5.        3.        2.        1.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.

                            PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                   CFS     2002.     1330.      774.      379.         37918.
                INCHES               2.24      5.20      5.32           5.32
                 AC-FT                660.     1535.     1568.          1568.
```

```
**********          **********          **********          **********          **********

                                        COMBINE HYDROGRAPHS

        ADOBE CREEK  AT  FOOTHILL  EXPWY    POINT 3

                               ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                                   3       2       0       0       0       0       1

                                        SUM OF 2 HYDROGRAPHS AT      3
      14.        32.        77.       147.       240.       248.       312.       410.       545.       682.
     784.       803.       792.       759.       744.       770.       799.       822.       823.       798.
     774.       761.       764.       786.       812.       838.       922.      1090.      1185.      1144.
    1170.      1342.      1496.      1564.      1809.      2411.      2748.      2174.      1708.      1521.
    1348.      1191.      1087.       977.       922.       876.       846.       797.       693.       499.
     344.       240.       165.       121.        91.        71.        51.        37.        27.        19.
      14.         9.         7.         4.         3.         1.         1.         0.         0.         0.
       0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
       0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
       0.         0.         0.         0.         0.         0.         0.         0.         0.         0.

                                 PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                        CFS     2748.     1707.      983.      481.         48058.
                     INCHES                2.24      5.15      5.25           5.25
                      AC-FT                847.     1950.     1987.          1987.
```

306 AC-FT

[illegible]

## COMBINE HYDROGRAPHS

ADOBE CREEK AT EL CAMINO    POINT 4

FLOW RATES TAKEN AT 1/2 HOUR INTERVALS

```
  23    44    92   178   296   345   397   515   659   828
 948   987   974   948   925   945   976  1001  1007   986
 961   946   946   965   992  1019  1089  1246  1366  1346
1346  1499  1670  1753  1953  2501  2938  2526  1954  1762
1590  1430  1316  1212  1141  1102  1065  1023   931   754
 578   468   395   336   302   279   261   242   227   215
 207   200   194   189   185   148    73    36    18     9
   4     2     1     1     0     0     0     0     0     0
   0     0     0     0     0     0     0     0     0     0
   0     0     0     0     0     0     0     0     0     0
```

PEAK FLOW RATE = 2938 CFS

## COMBINE HYDROGRAPHS

ADOBE CREEK [redacted]
LOCATED HALF WAY BETWEEN POINT 3 AND POINT 4 (average of Pts. 3 & 4)

FLOW RATES TAKEN AT 1/2 HOUR INTERVALS

```
  18    38    84   162   268   296   354   462   602   755
 866   895   883   854   834   858   888   912   915   892
 868   854   855   876   902   928  1006  1168  1276  1245
1258  1420  1583  1658  1881  2456  2843  2350  1831  1642
1469  1310  1202  1094  1032   989   956   910   812   626
 461   354   280   228   196   175   156   140   127   117
 110   104   100    96    94    74    37    18     9     4
   2     1     0     0     0     0     0     0     0     0
   0     0     0     0     0     0     0     0     0     0
   0     0     0     0     0     0     0     0     0     0
```

PEAK FLOW RATE = 2843 CFS

```
                  **********          **********          **********          **********

                                   COMBINE HYDROGRAPHS

      ADOBE CREEK   U/S BARRON CRK   AT BAYSHORE      POINT 5

                     ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                         5       2       0       0       0       0       1

                               SUM OF 2 HYDROGRAPHS AT      5
    26.       50.       99.      203.      333.      427.      485.      593.      760.      950.
  1112.     1175.     1175.     1151.     1126.     1131.     1162.     1190.     1202.     1190.
  1164.     1146.     1141.     1154.     1180.     1208.     1263.     1395.     1537.     1561.
  1542.     1649.     1830.     1944.     2108.     2569.     3080.     2902.     2291.     2001.
  1870.     1697.     1570.     1467.     1384.     1337.     1301.     1260.     1196.     1034.
   849.      716.      637.      571.      525.      497.      475.      454.      435.      420.
   408.      398.      390.      292.      237.      189.      119.       58.       37.       21.
    11.        6.        3.        1.        1.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.

                         PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
               CFS      3080.     2126.     1375.      721.         72063.
            INCHES                 1.82      4.72      5.15           5.15
             AC-FT                 1055.     2728.     2979.          2979.
```

**SANTA CLARA VALLEY WATER DISTRICT**

# ADOBE CREEK PHASE IV

# SUPPLEMENT TO
# FLOOD CONTROL ALTERNATIVE ANALYSIS
(DATED JUNE 21, 1989)

## ALMA STREET TO EL CAMINO REAL

prepared by

David E. Hook, P.E.
Associate Civil Engineer
with
Kurt Flammer
Assistant Civil Engineer
under the direction of

James M. Fiedler, P.E.
Senior Engineer, Design Division

Ronald R. Esau
General Manager

Robert R. Smith
Flood Control Manager

August 2, 1989

## TABLE OF CONTENTS

Page
Preface.....1
Summary.....2
Project Alternatives
1. Upstream Storage - Combination of Sites.....3
2. Partial Channel Replacement with New Trapezoidal & 17-foot U-frame Channel.....18
3. Diversion with Upstream Storage.....22
4. Diversion (Revised Flow Amount).....24

APPENDIX

1. Letter from Libby Lucas
2. Memorandum from Tom Iwamura

FIGURES

1 Upstream Storage Sites.....4
2. Hidden Villa (Lower Pasture) - Plan.....6
3. Hidden Villa (Lower Pasture) - Cross-Section.....7
4. O'Keefe Lane - Plan.....10
5. O'Keefe Lane - Cross Section.....11
6. Foothill Expressway - Plan.....13
7. Foothill Expressway - Cross-Section.....14
8. Partial Channel Replacement - Trial 1 - Profile.....20
9. Partial Channel Replacement - Trial 2 - Profile.....21

TABLES

1. Comparative Summary of Six Reservoir Sites.....16

# APPENDIX F

# AMENDMENT TO THE DRAFT EIR

# AMENDMENT TO THE DRAFT EIR
# CONSISTING OF COMMENTS, RESPONSES TO COMMENTS AND TEXT REVISIONS
# FOR
# ADOBE CREEK CHANNEL IMPROVEMENTS
# CHARLESTON ROAD TO EL CAMINO REAL

SANTA CLARA VALLEY WATER DISTRICT
APRIL, 1990

# TABLE OF CONTENTS

| | | PAGE |
|---|---|---|
| I. | LIST OF PERSONS AND AGENCIES COMMENTING ON THE DRAFT EIR | 1 |
| II. | RESPONSES TO COMMENTS ON THE DRAFT EIR | 1 |
| III. | REVISIONS TO THE TEXT OF THE DRAFT EIR | 11 |
| IV. | COMMENTS ON THE DRAFT EIR | 12 |
| V. | MINUTES FROM THE PUBLIC HEARING | 29 |
| VI. | NOLTE & ASSOCIATES REPORT | 36 |

# I. LIST OF PERSONS AND AGENCIES COMMENTING ON THE DRAFT EIR

| Agency/Individual | Response Required | Date Received |
|---|---|---|
| City of Palo Alto Public Works Department | Yes | January 26, 1990 |
| California Department of Fish & Game | Yes | January 12, 1990 |
| California Department of Transportation | Yes | January 4, 1990 |
| Gilbarg, David | Yes | January 26, 1990 |
| League of Women Voters | Yes | January 26, 1990 |
| Lucas, Libby | Yes | January 26, 1990 |

# II. RESPONSES TO COMMENTS RECEIVED ON THE DRAFT EIR

## RESPONSES TO COMMENTS ON THE DRAFT EIR FROM CITY OF PALO ALTO PUBLIC WORKS DEPARTMENT, RECEIVED ON JANUARY 26, 1990

1. COMMENT: The Planning Department concerns are primarily focused on impacts to the rear yards of the private residents. Although construction noise and dust impacts are only temporary, measures should be taken to limit these impacts as much as possible. Contractors shall be subject to the City's Noise Ordinance (Section 9.10.060 of the Palo Alto Municipal Code) including limited operating hours. Additionally, dust control measures should be implemented, including two daily waterings of exposed earth surfaces and daily street and dirt haul route cleaning. This dust control program should be monitored by the Public Works Department with the contractor being financially responsible for controlling dust nuisances originating from the contractor's operations either inside or outside of the right-of-way.

1. RESPONSE: As stated on page 25 of the DEIR, the City of Palo Alto regulations for noise and dust would be contained in the building contract specifications, which define the contractor's responsibilities, and would be implemented during project construction. The project proposes dust control measures, however, a mandatory condition of watering of all exposed earth surfaces could aggravate sidewall sloughing and disturbance of backyards. The City of Palo Alto may monitor dust control during construction, if it so desires, but shall not direct the District's contractor. Only the District's inspectors shall give direction to the contractor.

2. COMMENT: Planning Staff is also concerned with the removal of a significant number of mature trees from the creekside area as identified in Table 3. These trees and other existing vegetation significantly soften the visual impacts of the concrete drainage ditch. Staff does not feel that the proposal to reduce visual impacts by installing a new six-foot-tall fence around the flood walls is adequate. The EIR should identify ways to save as many significant trees as possible. Those trees that must be removed which have diameters of 6 inches or more should be replaced with similar trees that are at least 48-inch box specimen trees. Additional landscaping including shrubs and ground cover should be installed to further soften the visual impact.

2. RESPONSE: The proposed project includes provisions to minimize the disturbance to vegetation during construction, as described in the Project Description and Construction Impacts sections of the Draft EIR. In addition, fences are proposed to help screen the new channel walls,

and monetary compensation would be provided to reimburse property owners for removed vegetation. The SCVWD is not proposing to undertake the actual planting of private landscaping for vegetation removed in adjacent backyards, because to do so would preempt the individual choices of property owners for landscaping of their private yards.

## RESPONSE TO COMMENTS ON THE DRAFT EIR FROM DEPARTMENT OF FISH AND GAME, RECEIVED ON JANUARY 12, 1990

3. COMMENT: Department of Fish and Game personnel have reviewed the proposed Adobe Creek DEIR for a Santa Clara County Water District project which would widen and heighten the existing concrete-lined channel from Charleston Road to El Camino Real. For the reasons indicated below, we recommend against certification of the DEIR.

Adobe Creek is not presently recognized as a creek supporting a significant migratory salmonid fishery. However, the narrow riparian corridor provides habitat for both residential and migratory species of birds, mammals, and other wildlife species. Loss of this habitat would force wildlife to utilize adjacent habitats that are currently at their capacity. Thus, encroachment upon these areas would result in loss of those wildlife populations utilizing riparian areas which would be negatively impacted. The Department views this loss of riparian vegetative communities and wildlife as a significant adverse impact.

3. RESPONSE: The vegetation that would be removed for construction of the project is not considered riparian. Rather, this vegetation consists of a variety of introduced horticultural species that have been planted along the backyards of adjacent houses. The loss of this vegetation would reduce habitat for common urban wildlife, as described in the DEIR. However, this vegetation and associated wildlife is not native (indigenous) and therefore, its loss is not considered a significant environmental impact.

4. COMMENT: The DEIR should address measures to mitigate for the loss of riparian associated species such as redwoods, alders, and willows, as well as understory species. Vegetative losses above the Southern Pacific Railroad culvert should also be enumerated and mitigated. The DEIR is inadequately detailed for compliance with California Environmental Quality Act requirements related to requisite specificity regarding impact disclosure and precise description of mitigation measures. It is the policy of the Department to oppose the authorization of projects which would result in a net loss of either wetland acreage or wetland habitat values.

4. RESPONSE: As described in the previous response, no riparian or wetland habitat is located within the project boundaries. The redwoods, located in some adjacent backyards, are not native to the Santa Clara Valley bottomlands, and is not considered riparian vegetation. Three willow saplings were encountered in the creek bottom upstream of the SP culvert. The value of these saplings, however, is greatly limited by channel maintenance (including clearing of vegetation within the creek channel), which is performed in accordance with an Memorandum of Understanding (MOU) with the Department of Fish and Game.

The vegetation (adjacent to Adobe Creek) upstream of the SP culvert is generally the same as that described for the lower portion of the project, consisting of introduced horticultural species of trees and shrubs which provide habitat largely for common species of urban-adapted birds.

The project would not result in any loss of wetland or wetland habitat values, due to the absence of indigenous riparian/wetland species within the project site. Existing vegetation within the channel is negligible, and sediment supporting emergent vegetation is minimal in most areas.

5. COMMENT: Consequently, we recommend that, prior to certification of the DEIR, the project sponsor devise a compensation plan which, when implemented, would assure that the project does not result in a net loss of either wetland acreage or wetland habitat values. This plan should be prepared as a focused Supplemental DEIR; circulated for public review and comment; and, if adequate, to achieve the goal of no net loss of both wetland acreage and wetland habitat values, incorporated as an enforceable condition of certification of environmental documentation per the project.

5. RESPONSE: No loss of wetland or wetland habitat values would result from the replacement of the existing concrete-lined channel, as stated in response to the previous comment. Therefore, no compensation for wetlands would be necessary and a supplemental DEIR is not required.

6. COMMENT: The project design includes a "U" shaped concrete-lined channel without a recognizable low-flow channel. We recommend the design be modified to provide a low-flow channel, as well as providing for migratory fish passage. We recommend that this design modification be incorporated into the previously recommended focused Supplemental DEIR.

6. RESPONSE: The proposed U-frame channel would have a cross-slope of two percent, which would concentrate water flow to one side of the channel and function as a low-flow channel. This cross-slope is similar to that of the downstream U-frame channel constructed in 1989, which was approved by the Department of Fish and Game under a streambed alteration agreement.

7. COMMENT: Before project implementation, a streambed alteration agreement from our Department must be obtained. This should not be requested until all other applicable permits have been obtained.

7. RESPONSE: The SCVWD will comply with the Department of Fish and Game permitting requirements for the proposed channel replacement.

8. COMMENT: In summary, and for those reasons previously indicated, we recommend against the certification of the subject DEIR at this time. However, given the preparation of a wetland compensation plan and incorporation of our recommended design modification, we would remove our objection to certification of this DEIR. Department personnel are available to assist in the development of compensation strategies as well as incorporation of our recommended design modification.

8. RESPONSE: As stated previously, no loss of wetland or wetland habitat values would result from the replacement of the existing concrete-lined channel. Therefore, a wetland compensation plan is not required. The EIR fully complies with CEQA and has accurately assessed the impacts of the project on fish and wildlife resources.

## RESPONSES TO COMMENTS ON THE DRAFT EIR FROM THE DEPARTMENT OF TRANSPORTATION, RECEIVED ON JANUARY 4, 1990

9. COMMENT: The California Department of Transportation (Caltrans) has reviewed the above referenced document and has the following comments:

The environmental document fails to address the impacts of this project on Caltrain rail service. As we stated in our response to the Notice of Preparation for this document (May 10, 1989), the delays caused by the track relocation may result in a loss of ridership for Caltrain. The Environmental Impact Report must address the impact of this project on Caltrain and proposed mitigation for the impacts.

9. RESPONSE: Relocation of the railroad line along Alma Street, described on page 22 of the Draft EIR, would be required for construction of the SP culvert on Adobe Creek. This new portion of rail line (or "shoofly") would be pre-constructed and put in place within a day or less, causing minimal or no interruption of service. This brief delay would not represent a significant interruption in rail services.

## RESPONSES TO COMMENTS ON THE DRAFT EIR FROM DAVID GILBARG, RECEIVED ON JANUARY 26, 1990

10. COMMENT: I wish to call attention to serious risks in the Preferred Alternative for the Adobe Creek Channel and to urge that other alternatives to be given greater consideration. The proposed design is based on various hydraulic assumptions, including clear water flow, a Manning roughness coefficient n = .015 and downstream supercritical flow.

10. RESPONSE: The methods used by the District to evaluate the hydraulics on Adobe Creek are methods accepted and adopted by the flood control industry. Due to the unique aspects of this project (citizen concerns, existing channel geometry), the services of a design consultant, Nolte & Associates, were retained to review our hydraulic assumptions and design. They found our hydraulic assumptions reasonable for this project and concluded that the "hydraulic performance for the preferred alternative should be more stable than the present configuration" (a copy of this report is attached to this Amendment).

11. COMMENT: The flooding of the similarly designed Corte Madera Creek in 1982 and 1986 shows that these assumptions may break down in larger flood flows, causing higher surface elevations and consequent flooding. Specifically, the Corte Madera Creek Channel design assumed a Manning roughness n = .014 whereas the composite roughness due to sediment in the channel was at least .03, causing subcritical flow, higher than predicted flood elevations and then flooding. This phenomenon and debris obstruction, which obviously can also affect the hydraulics, are to be expected in a major flood. (For details and a fuller discussion see the attached article, "Rethinking flood-control channel design," by P. Williams in Civil Engineering, January 1990.)

11. RESPONSE: According to the Corps of Engineers (Corte Madera Creek Sedimentation Study - Technical Report HL-86-6, dated April 1989), flooding of Corte Madera Creek was due to an inadequate natural channel in upstream reaches, and sediment buildup in the concrete U-frame channel in the downstream reach. The risks of flooding due to sedimentation on Adobe Creek are much less. Sediment buildup has never been a problem in this reach of Adobe Creek. The proposed project would remove the existing drops, increase velocities and further reduce the probability of deposition. District maintenance crews monitor the sediment and vegetation levels annually and remove sediment deposits in all lined sections of Adobe Creek as required before each winter season (as outlined in the Final Negative Declaration of the Adobe Creek Planning Study, dated June, 1985). In addition, the maintenance crews monitor the streams in the winter, especially after large flows have occurred, and remove the sediments as required. Therefore, sediment deposits in Adobe Creek are held to a minimum. Flooding and erosion problems in the

upstream reached of Adobe Creek from El Camino Real to El Monte Avenue are the subject of a current planning study.

Corte Madera Creek and Adobe Creek are also different with respect to their available freeboard. Adobe Creek is designed with a minimum two feet of freeboard in the upstream steep reaches and three feet of freeboard in the flatter, downstream reaches. Corte Madera was designed with only one foot of freeboard.

12. COMMENT: The design of the proposed Adobe Creek 20' U-frame channel assumes a Manning n = 0.15 and channel capacity of 3100 cfs. Standard conveyance calculations show that the creek will overflow the free board and there will be flooding if the effective n = .024. This is a smaller increase in n than in the Corte Madera Creek flood where (as noted above) n reached .03.

The existing Adobe Creek channel has not flooded in the Alma To Charleston reach since its construction in the 50's and, with improvement of the SP culvert, will protect against a 2% flood but presumably not against the larger but rarer 1% flood. Tearing up the present channel and replacing it with the proposed alternative will cause significant impact and as we have seen will still carry the risk of flooding.

12. RESPONSE: Overflow of the proposed U-frame channel would not occur unless the actual Manning's n in the channel is above n =.024 (refer to the previous response). Some risk of flooding is always present in all open channels regardless of their size, shape, or location. The proposed project will significantly reduce the level of risk. Presently, flooding is certain to occur much more frequently than the 1% event.

13. COMMENT: A more rational solution to the problem of rare flood would be a system of temporary retention which would be activated only in the rare case of large flooding. Admittedly, there are problems including costs in such a program, but this approach would be less risky and less damaging in the long term.

13. RESPONSE: This upstream storage alternative was examined in depth in Section III and Appendix E of the DEIR. The costs and environmental impacts of the upstream storage alternative far exceed those of the proposed alternative.

## RESPONSES TO COMMENTS ON THE DRAFT EIR FROM THE LEAGUE OF WOMEN VOTERS, RECEIVED ON JANUARY 26, 1990

14. COMMENT: In reviewing the Draft Environmental Impact Report for Adobe Creek Channel Improvements from Charleston Road to El Camino Real, there are impacts to the environment that we feel have not been thoroughly assessed.

The League of Women Voters supports measures which promote the management and development of water resources in ways that are beneficial to the environment with the emphasis on conservation and high standards of water quality that are appropriate for the intended use. I believe this is very close to your own mandate as a water conservation and flood control district.

The League also supports measures that reserve stream flows for protection of fish and wildlife habitat and other instream uses.

As stated in your environmental assessments, construction of the project would result in the removal of trees and other vegetation located above the creek channel and in adjacent backyards, and will result in a loss or disturbance of a nesting area for resident or migrating birds. The only mitigation offered is monetary compensation to the property owners.

14. RESPONSE: As stated on page 31 of the DEIR, the project would result in a substantial loss of landscaping to backyards. The project would not, however, result in a considerable loss of *native* vegetation or wildlife habitat and therefore, the impacts to these resources would not be significant.

15. COMMENT: A natural riparian greenbelt is a resource to an entire community as well as providing the vital link in the habitat of birds, fish and land animals. This project should still maintain the viability of fish migration upstream in a low flow channel with enough shade protection to preserve a viable water temperature.

15. RESPONSE: The project reach of the Adobe Creek channel does not constitute a riparian greenbelt, since it is a concrete-lined creek channel abutting an urban landscape of adjacent backyards. There are presently no provisions for for fish migration in the existing concrete channel. The proposed project, however, would include a channel bottom design that will allow for fish migration during low flow conditions (refer to previous responses to comments from the Department of Fish and Game).

16. COMMENT: Ideally, some continuity of greenery would be maintained on at least one bank. If this is not possible, then mitigation might provide substitute habitat. The conversion of your staging area to a streamside park would provide one oasis of greenery, but box culvert plantings should also be considered.

16. RESPONSE: As described in the Draft EIR, provisions will be made during construction to minimize the impacts to trees and other vegetation. The SCVWD is not proposing to provide private landscaping for vegetation removed in adjacent backyards, because to do so would preempt the individual choices of property owners for landscaping of their private yards. Providing a "continuity of greenery" on one bank of the creek would require the purchase of several homes along the channel and the displacement of these homeowners.

17. COMMENT: The project will result in an impact upon the quality and quantity of existing recreational opportunities, as stated in your initial study, and there is no mitigation mentioned in this area. Scout troups did hike from the baylands to Los Altos and Los Altos Hills at one time.

17. RESPONSE: The existing Adobe Creek channel between Charleston Road and El Camino Real is intended for flood protection and does not provide any recreational opportunities. The replacement of the concrete-lined channel, therefore, would not result in any impacts to recreation, and no mitigation is required.

18. COMMENT: In the area of water quality, the removal of marsh grasses and sediments which have a cleansing effect on water should be noted. Mitigation might encompass a review of non-point source storm drain outfalls to the creek and methods to screen out pollutants.

These sources of routine point and non-point pollution, such as the stormwater runoff from excessive parking areas as in the San Antonio Shopping Center, should be incorporated, ideally, into the flood control project at this time.

18. RESPONSE: The project would not disturb any existing marsh grasses or other natural habitat which has a cleansing effect upon surface water entering Adobe Creek. The project is proposing the replacement of an existing concrete-lined channel, and does not include improvements that would affect point or nonpoint sources of pollutants.

19. COMMENT: The League of Women Voters of the Los Altos - Mountain View Area noted, when this environmental study was initiated a year ago, that according to the guidelines set forth by the California Environmental Quality Act, the entire flood control project that is envisioned for Adobe Creek should be represented in the EIR.

As a phased project with significant environmental effects, the Lead Agency shall prepare a single EIR for the ultimate project as described in Section 15168. Scoping and cumulative impacts are inherent in a flood control project that extends from the Bay to the mountains, and therefore the full program EIR we feel is mandated under CEQA guidelines.

19. RESPONSE: As stated in the Preface of the DEIR, a Negative Declaration was adopted in 1985 for the larger flood control project extending along Adobe Creek between the Palo Alto Flood Basin and El Camino Real. The DEIR addresses the specific modifications which were made to the design of the flood control improvements between Charleston and El Camino Real, subsequent to adoption of the Negative Declaration. The other flood control improvements on Adobe Creek, addressed in the Negative Declaration, have been completed.

20. COMMENT: As two thirds of the watershed of Adobe Creek is in mountainous land that is to a large extent in protected open space, and as the creek travels through conservation easements and parks and quiet suburban neighborhoods, ultimately flowing out to the Palo Alto Baylands wildlife preserve, the conservation of natural resources along this creek is of paramount importance.

The League supports positions which encourage offstream storage, but without considering the benefit of any such diversion and the attendant cost of land acquisition as it affects all the residents along the length of Adobe Creek, the cost-benefit ratio suffers if it is analyzed only in relation to this one stretch from Charleston to El Camino Real.

Sound flood control practices should encompass all possible aspects of water conservation and the preservation of water quality, but without losing sight of the requirements of fish and wildlife and recreation.

20. RESPONSE: As described in the PROJECT OBJECTIVES section of the Draft EIR on page 4, the proposed flood control improvements were designed to provide flood protection in order to reduce the impacts associated with continued flooding. The environmental impacts of the proposed project have been described within their respective sections of the Draft EIR and mitigation measures have been provided as appropriate.

## RESPONSES TO COMMENTS ON THE DRAFT EIR FROM LIBBY LUCAS, RECEIVED ON JANUARY 26, 1990

21. COMMENT: In reviewing the Draft Environmental Impact Report for Adobe Creek Channel Improvements, Charleston Road to El Camino Real, Project #1010, there are a number of concerns which I find have not been adequately addressed.

Primarily, it does not present the support documentation in regards to management of the watershed, and the causes of the flooding that has taken place over the past ten years in the upstream segments of Adobe Creek.

21. RESPONSE: The DEIR was prepared in response to design changes of a specific reach included within the larger flood control project extending along Adobe Creek between the Palo Alto Flood Basin and El Camino Real, as described in the Preface. A Negative Declaration was adopted in 1985 for this larger flood control project, which describes in more detail the background for improvements to this channel. This document, "Adobe Creek Planning Study, Engineer's Report and Final Negative Declaration," is referenced in the DEIR and available for review from the SCVWD.

22. COMMENT: Congress now requires that all federally funded flood control efforts consider acquiring watershed property before proposing more costly construction. The concept is that by obtaining restrictive easements, or easements to flood, that the land is preserved in a natural state that benefits all concerned. And that in Boston, has cost one tenth of what traditional construction would have cost, to flood proof the downtown Charles River area.

22. RESPONSE: The project is proposed and will be funded entirely by the Santa Clara Valley Water District, a local public agency. None of the proposed channel improvements would utilize federal funds.

23. COMMENT: Wetlands and floodplains have historically reduced soil loss and excessive runoff. Creeks and streams retained in their natural state maintain water quality, wildlife diversity, aesthetic value and recreational opportunities.

As the upper 2200 feet in elevation of this watershed of Adobe Creek is largely in conservation as permanent open space, it would seem that the major portion of this acquisition has already been accomplished, by the donation of the Duveneck family of the Hidden Villa Ranch, and by the land acquisition of the Mid Peninsula Open Space District.

CEQA guidelines also instruct that an environmental review should encompass all phases of a project, "The Program EIR can:

1) Provide an occasion for a more exhaustive consideration of effects and alternatives than would be practical in an EIR on an individual action,
2) Ensure consideration of cumulative impacts that might be slighted in a case-by-case analysis,
3) Avoid duplicative reconsideration of basin policy consideration,
4) Allow the Lead Agency to consider broad policy alternatives and program wide mitigation measures at an early time when the agency has greater flexibility to deal with basic problems or cumulative impacts, and
5) Allow reduction in paperwork." Section 15168

In light of these guidelines it seems mandatory at this time to seriously review the options for upstream retention and preservation of floodplains, and conservation setbacks, if they will, in any way lessen or mitigate peak flows from the 100 year event or flood.

The only suggested options that appear viable at this time are the lower pasture of Hidden Villa preserve and the Los Altos Hills open space 8 acre parcel at #280 and O'Keefe. Both of these properties offer some flood control capability and both have value for wildlife and aesthetic preservation and recreational opportunities. Both need purchase of easements to flood. Exhibit A enclosed.

Some channel improvement is needed between the Hidden Villa entrance road bridge and the 11 acre lower pasture and perhaps part of the flood easement cost might be in payment for these improvements. Ideally the pasture could continue in recreational use and the flood control easement would only be triggered under peak flow conditions. A one purpose use as a reservoir is not my suggestion.

The additional location at #280 would entail the purchase of flood easements, if not the property itself as permanent open space, of the old Schilling land that runs adjacent to the Los Altos Hills open space parcel. This, again ideally, would remain as recreational riding land and only be bermed to detain peak flows from Adobe Creek, that would drain gradually at the Purisima and O'Keefe end. Percolation might be feasible here, see attached exhibit B.

A third capability for retention might be on the Los Altos Hill Byrne Park preserve which encompasses 60 acres of watershed.

The other locations mentioned, Foothill College fields, and the low bowl adjacent to Foothill Expressway will flood naturally under peak flow conditions and look to remain in open space. The same natural flooding will occur on Adobe between O'Keefe and Edith along the conservation easements and parks.

23. RESPONSE: The SCVWD has thoroughly investigated the feasibility of a possible upstream storage detention as an alternative to the proposed project, as documented in Appendix E. The project does not propose to affect any floodplain values, but rather to reduce property damage from flooding during the (up to) 100 year flows. All of the upstream storage alternatives and other possible alternatives would have substantially greater impacts than the proposed project.

24. COMMENT: Secondly, the subject of water quality is not stressed sufficiently. The planting of grasses and willow wattles in the buffer areas around the large paved parking lots at Foothill College would be a mitigation water quality measure of some merit. In this segment from Charleston Road to El Camino there is the outfall from the San Antonio Shopping Center, I believe, and some water quality non-point source pollution mitigation should be offered.

24. RESPONSE: The project proposes the replacement of a concrete-lined creek channel and would not significantly affect existing water quality within Adobe Creek. The project, therefore, would not require improvements related to point or nonpoint sources of pollutants.

25. COMMENT: Under peak flow conditions do the street drains empty onto Adobe?

25. RESPONSE: Under the 100-year flow conditions, the street drains would not immediately empty into Adobe Creek, but would be attenuated.

26. COMMENT: Thirdly, there is no mitigation suggested for the conversion of a public asset, a trapezoidal channel with ivy has some appeal, to a bleak cement box culvert that poses a hazard for humans and animals alike. The height and steepness of the 10 foot wall make it impossible

to extricate oneself from even a low and slow moving stream. Along with fish ladders, how about a few human ladders.

26. RESPONSE: The project proposes the replacement of the existing trapezoidal channel with a U-frame channel, not with an underground box culvert. The visual impacts of the new channel are addressed in Section E. VISUAL, of the Draft EIR. The construction of steel ladders (for emergency egress and access) along the creek channel is proposed as part of the Adobe Creek channel improvements, as identified on page 26 of the DEIR. The project does not propose to provide fish ladders in the new channel (refer to responses to comments from the Department of Fish and Game).

## RESPONSES TO COMMENTS RAISED DURING THE PUBLIC HEARING

On January 18, 1990, a public hearing was conducted before the Santa Clara Valley Water District Board of Directors on the Draft EIR for the Adobe Creek Channel Improvements (Charleston Road to El Camino). A transcript of the entire public hearing is included in Section V of this Amendment (attached). During the public hearing, comments were made on the DEIR by the following persons:

- Bob Moss
- R.A. Jensen
- Franz Wagner
- Pat Morris
- Diane Foote
- Libby Lucas
- Ann Justice

Most of the comments made during the public hearing were responded to during the meeting, as documented in the transcript contained in Section V. Comments that did not receive response or were not resolved during the meeting are addressed below.

27. COMMENT: **Bob Moss** stated that the DEIR was inconsistent because it identified the visual impacts of the project to be significant (due in part to vegetation removal), and the vegetation and wildlife impacts to be nonsignificant.

27. RESPONSE: As stated on page 31 of the DEIR, the project would result in a substantial loss of landscaping to backyards. These landscaping species, however, do not consist of native vegetation providing significant wildlife habitat. Therefore, the impacts would not be significant. (Please refer to responses to comments from the Department of Fish and Game.)

28. COMMENT: **Libby Lucas** expressed concern about the concept of upstream retention, and hoped that there was some way to retain the floodplain areas still left on Upper Adobe Creek. She also questioned fish migration in the low flow channel the way it is now designed.

28. RESPONSE: The SCVWD has thoroughly investigated the feasibility of a possible upstream storage detention as an alternative to the proposed project, as documented in Appendix E. As described in Section III. ALTERNATIVES, of the Draft EIR, the upstream detention alternatives would result in far greater environmental impacts than the proposed project.

At present, the existing concrete channel does not contain any provisions for fish migration. The proposed project, however, would include a channel bottom design that will allow for fish migration during low flow conditions.

## III. REVISIONS TO THE TEXT OF THE DRAFT EIR

The following are revisions to the text of the Draft EIR. All deletions are shown with a ~~line through the text~~, and all new wording is indicated with underlining.

Page ii, right column, third paragraph, the first sentence is revised as follows:

> The construction area would ~~should~~ be watered and swept as necessary to reduce dust in the project area.

Page ii, left column, the fourth paragraph is deleted and replaced with the following:

> The footbridge over Adobe Creek between Duncan Place and Creekside Drive has recently been placed out-of-service by the City of Palo Alto due to the October 17, 1989 earthquake. The footbridge would be replaced as part of the proposed Adobe Creek channel improvements.

Page ii, right column, the fourth paragraph is revised as follows:

> ~~The project proposes to limit the duration of footbridge inaccessibility to 2-4 months.~~ The earthquake damaged footbridge would be replaced by the proposed project.

Page 22, the fifth paragraph is deleted and replaced with the following:

> The footbridge over Adobe Creek between Duncan Place and Creekside Drive has recently been placed out-of-service by the City of Palo Alto due to the October 17, 1989 earthquake. The footbridge would be replaced as part of the proposed Adobe Creek channel improvements.

Page 25, the ninth paragraph is deleted, and replaced with the following:

> The footbridge over Adobe Creek between Duncan Place and Creekside Drive has recently been placed out-of-service by the City of Palo Alto due to the October 17, 1989 earthquake. The footbridge would be replaced as part of the proposed Adobe Creek channel improvements.

Page 43, sixth paragraph, the sixth sentence is revised as follows:

> A double 12 foot by 12 foot box culvert could be used ~~to~~ along Alma Street as shown on Figure ~~12~~ 13 and a 20 foot by 9.5 foot culvert could be used along Charleston Road as shown on Figure ~~13~~ 12.

Page 64, second paragraph, the first sentence is revised as follows:

> The project would result in the generation of high noise levels ~~dust,~~ and general disruption of backyards and property adjacent to the creek channel during construction.

# SECTION IV

# COMMENTS ON THE DRAFT EIR

# Preface

At the June 21 1989 Adobe Creek Phase IV Liaison Committee meeting, the District was asked to perform further analyses of flood control alternatives on Adobe Creek between Charleston Road and El Camino Real. These further analyses were to include upstream storage (additional sites), partial channel replacement with new trapezoidal & 17-foot U-frame channel sections, diversion with upstream storage, and diversion with revised flow amount.

This supplement to the June 21 report, Adobe Creek Phase IV Flood Control Alternative Analysis, presents these alternative analyses.

# SUMMARY

This supplement contains a description of the additional flood control alternatives for Adobe Creek between Charleston Road and El Camino Real. These additional alternatives are: (1) upstream storage (different sites); (2) partial channel replacement with new trapezoidal & 17-foot U-frame channel sections; (3) diversion with upstream storage; and (4) diversion with revised flow amount.

After considering these alternatives, we find that none of them would be preferable to the preferred alternative outlined in the June 21 1989 Flood Control Alternative Analysis report. The preferred alternative remains the 20 foot to 17 foot U-frame channel, which requires complete replacement of the channel in this reach. This plan will have moderate wall heights and visual impacts, moderate cost minimal long term environmental impacts, stable hydraulics, and lack of negative impacts on local drainage.

# UPSTREAM STORAGE ANALYSIS - COMBINATION OF SITES

## Background

At the June 21, 1989 Adobe Creek Phase IV Liaison Committee meeting, the District presented an analysis of the project alternatives.

Among these alternatives was an analysis of upstream storage sites. Four sites were examined. These sites are not feasible as alternatives for flood control on Adobe Creek due to excessive cost and environmental impacts.

At the meeting, Libby Lucas stated that she knew of upstream storage sites which were not examined. She also felt that the sites should be considered as acting in combination. Following the meeting, Libby Lucas supplied the District with a list of six potential sites for flood control reservoirs for further analysis (see attached letter, Appendix 1).

These sites are at:

Hidden Villa - Lower Pasture;
Foothill College;
O'Keefe Lane;
El Retiro;
Redwood Grove/Shoup Park; and
Foothill Expressway.

See Figure 1 for proposed reservoir locations.

These sites have been analyzed for flood control storage potential. They were considered as acting in combination. The added benefit of groundwater percolation was also considered.

## Summary

Only the Hidden Villa (Lower Pasture) and the Foothill Expressway sites are feasible for flood control reservoirs. The other sites are not feasible due to lack of right of way availability, induced flooding, and environmental impacts. These reservoirs reduce the flow at Alma Street by 600 cfs, to 2500 cfs. A 1% design flow of 2500 cfs would require the installation 6-foot floodwalls and the replacement of the Alma Street and SPTC culverts, along with the construction of both reservoirs, at a total cost of $16 million.

This is not a feasible alternative.

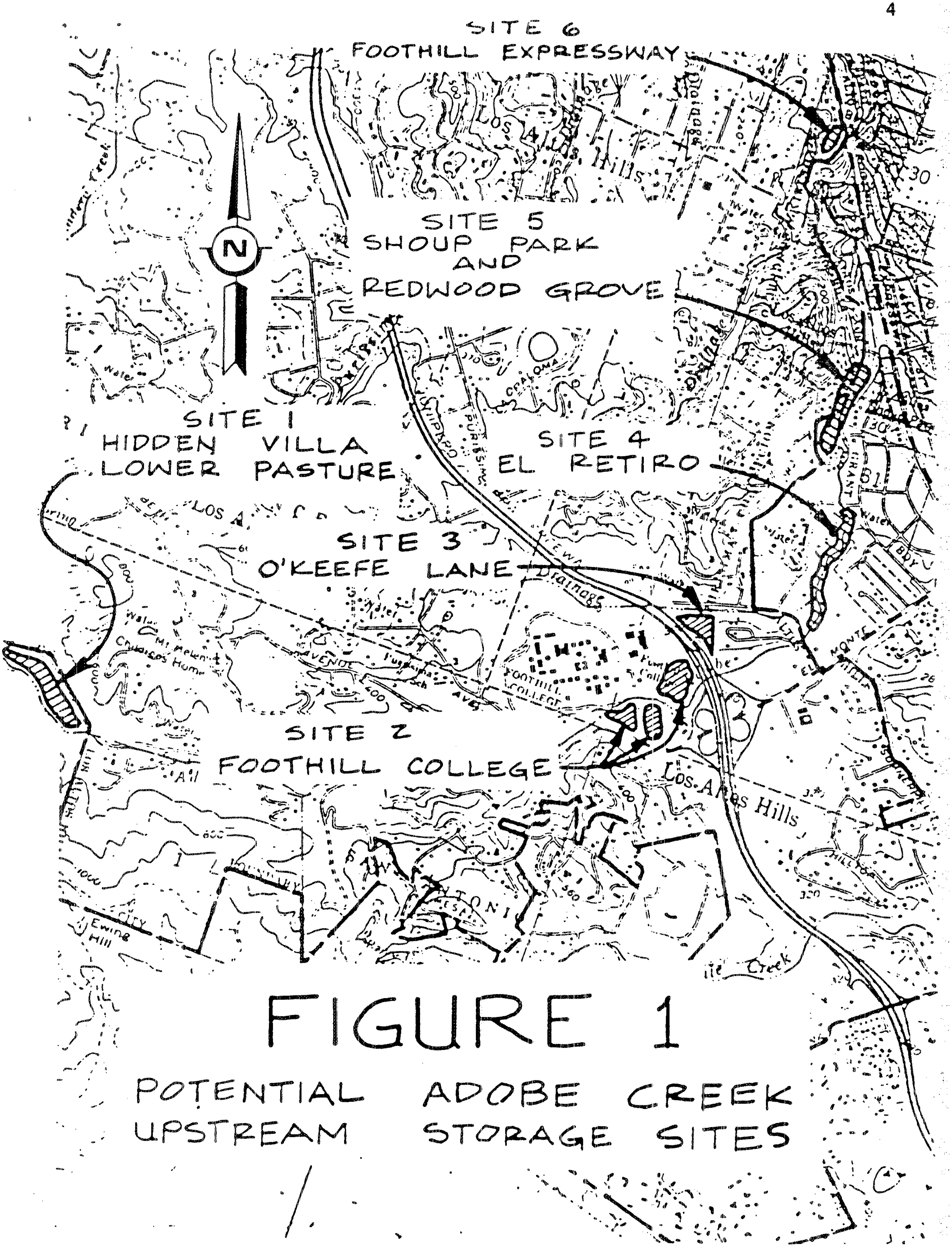


FIGURE 1

POTENTIAL ADOBE CREEK UPSTREAM STORAGE SITES

## Analysis Guidelines

Off-stream storage is desirable from a flood control perspective; this enables a more effective reduction in the design flow than on-stream storage. However, off-stream storage is also extremely sensitive to hydrology.

For both on-stream and off-stream storage, additional storage capacity must be reserved to account for the possibility of multiple storms.

Diversion structures for off-stream storage are very difficult to design, construct, and operate properly.

Flood control detention is a very "fragile" solution to flood control problems downstream. Any slight change in the watershed hydrology would negate it's effectiveness. The District would have to design any flood control reservoirs with additional safety factors, which would reduce their effectiveness and feasibility.

The performance of the flood control reservoirs considered herein, and the subsequent reduction in the 1% design flows at Alma Street, are based upon very optimistic, theoretical assumptions. Actual reductions in design flows might be less.

## Feasibility of Reservoir Sites

### Site 1. Hidden Villa - Lower Pasture

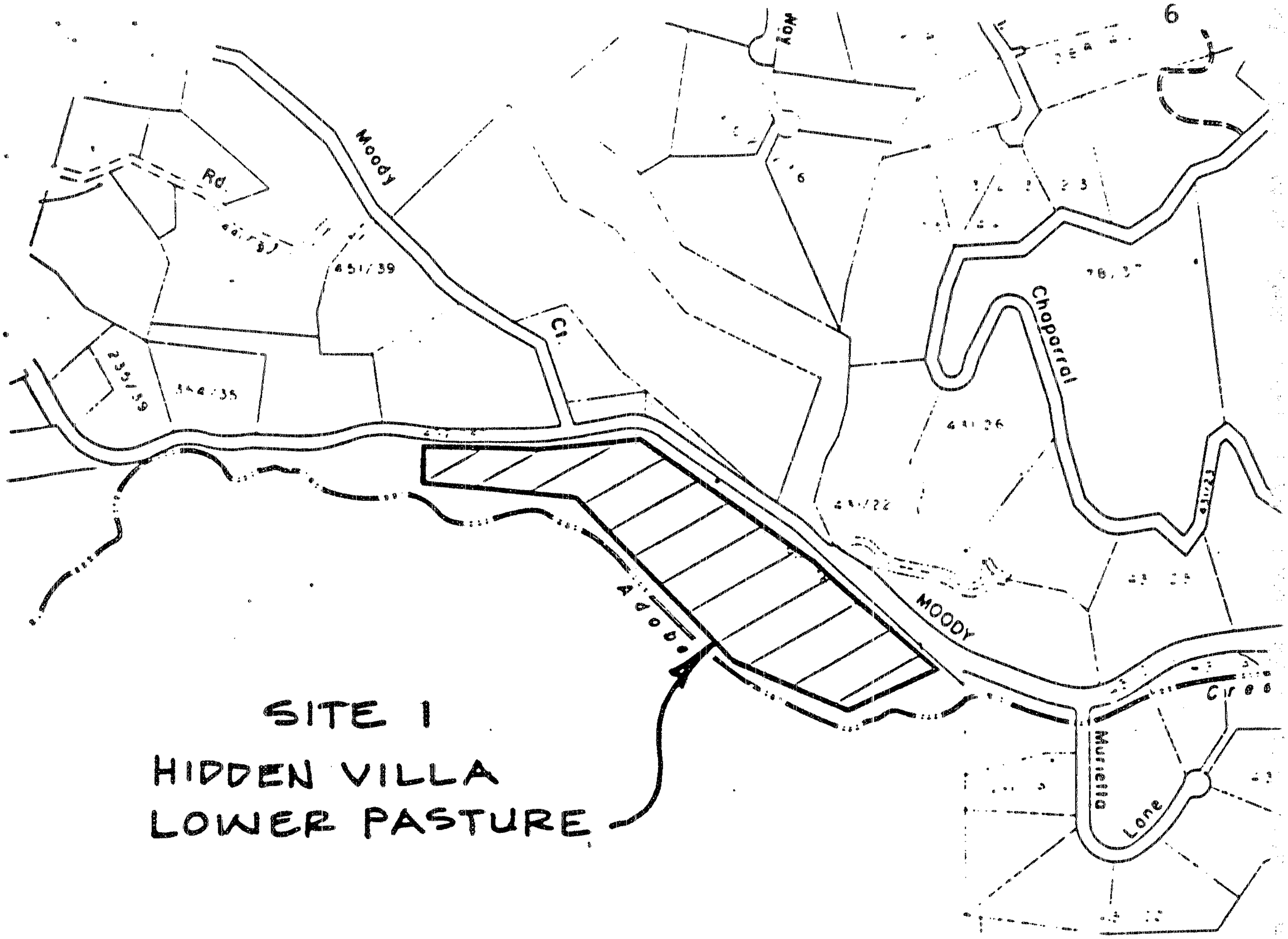
This reservoir site is located in the Hidden Villa Lower Pasture. It is bounded by Murietta Lane, Moody Road, the Hidden Villa entrance road, and Adobe Creek.

The lower pasture is currently leased for pasturage. There is no open space easement on it. It would be available for purchase. Anne Smith, the Director of the Trust for Hidden Villa, has stated that purchase at full market value would be required. The real estate cost would be about $10 million.

An off-stream flood control reservoir would be possible here. A reservoir could be excavated between Adobe Creek (leaving the creek intact) and Moody Road, with concrete diversion and outlet structures. The creek here has a high-value riparian habitat that is important to preserve.

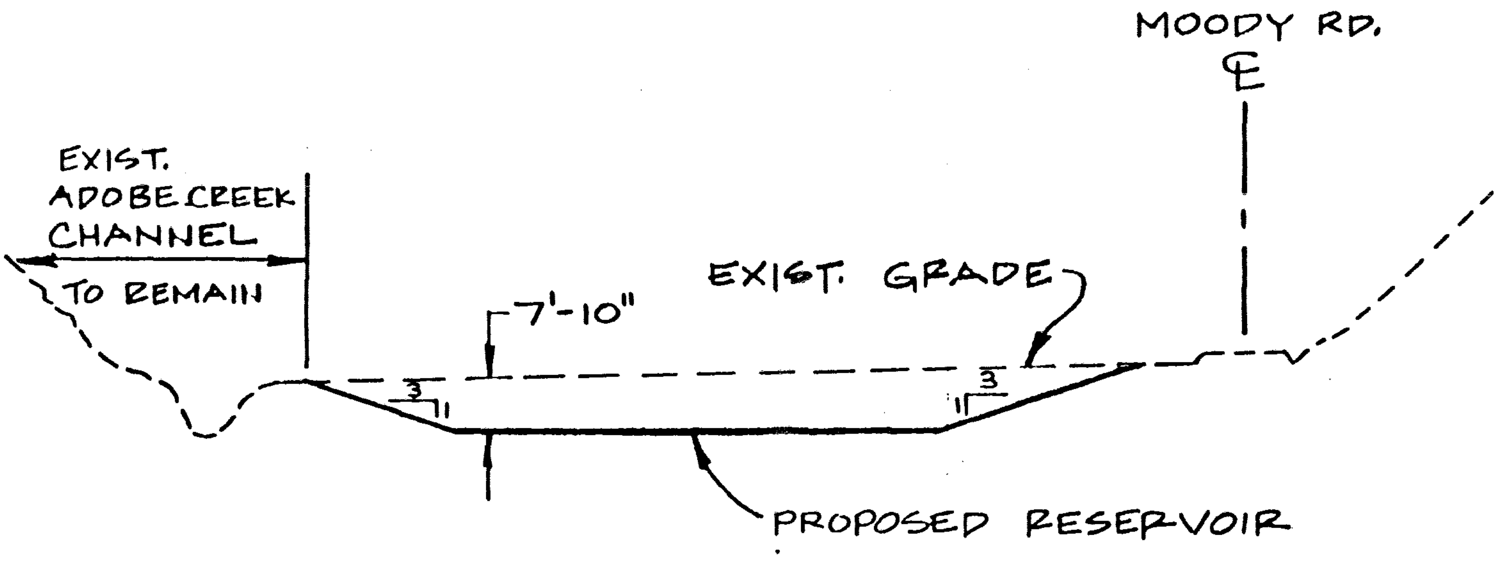
See Figures 2 and 3 for plan and cross-section.

Only 70 acre-feet could be stored here.



SITE 1
HIDDEN VILLA
LOWER PASTURE

FIGURE 2
PLAN



# FIGURE 3

HIDDEN VILLA-LOWER PASTURE
RESERVOIR CROSS-SECTION

NOTE:

1) CROSS-SECTION LOOKING UPSTREAM
2) NOT TO SCALE

## Conclusion on Site 1 Feasibility

Although a small reservoir could be constructed here with a moderate impact on the scenic values of the area, it would probably face opposition from local residents and conservation groups.

## Site 2. Foothill College (Parking Lot, Football Field/Track, and Baseball Field)

These reservoir sites (collectively, site 2) are located on the eastern side of Foothill College.

### Parking Lot

Parking lots deteriorate rapidly when flooded (asphalt tends to float). Flooding would also prevent parking lot use, which would disrupt the normal operation of the college. Floodwalls would be required around the parking lot, which would impede access. Flow to this site would have to be diverted 800 feet upstream through a rectangular box culvert (RCB).

### Football Stadium/Track

A new track was just installed here, at a cost of $750,000. Flooding would ruin this track. A floodwall would have to be installed around the northern end of the stadium, impeding access. Flow would have to be diverted 800 feet upstream through a rectangular box culvert (RCB).

### Baseball Field

For use as a flood control reservoir, floodwalls would have to be installed around this area. A weight lifting facility would have to be floodproofed.

### General

The use of any of these facilities as a flood control reservoir would have a severe impact upon the operation of the college, and would subject the facilities to costly flood damage.

The football field, track, and baseball field serve as the principal recreation areas for most of the physical education classes, intramural sports, and college teams. Flooding of these areas would disrupt these activities in a significant way.

Mal Leal, the Director of Plant Operations, has said that the college would fight strenuously any attempt to install flood control reservoirs on campus.

## Conclusion on Site 2 Feasibility

This is not a feasible site for flood control reservoirs.

### Site 3. O'Keefe Lane (on Purissima Creek)

This reservoir site is located on O'Keefe Lane between Purissima Creek and Highway 280.

The site consists of a mostly brushy plateau between Highway 280 and Purissima Creek. The plateau is about 10-15 feet higher than the creek bottom. The installation of a flood control facility here would require the removal of a large quantity (approximately 100,000 cubic yards, in 6,500 truck loads) of excess material.

See Figures 4 and 5 for plan and cross-section.

This site is Town of Los Altos Hills open space, and is popular with the town's citizens. Mr. Bill Ekern, Public Works Director, said that the town would not be willing to sell the property, or a portion of it, for a flood control reservoir. He further stated that we would have to go to court to obtain it.

## Conclusion on Site 3 Feasibility

This is not a feasible site for flood control reservoirs.

### Site 4. El Retiro

This site is located within the 80 foot conservation easement between O'Keefe Lane and Manresa Way on Adobe Creek.

Any flood control detention here would have to be on-stream, which is not very effective in reducing flood flow.

The 1% design water surface in this area is at the foundations of some of the buildings. Any attempts at flood control detention here would lead to flooding.

## Conclusion on Site 4 Feasibility

This is not a feasible site for flood control detention.

### Site 5. Shoup Park & Redwood Grove

This site is between Manresa Way and Burke Road on Adobe Creek.

Any flood control detention here would have to be on-stream, which is not very effective in reducing flood flow.

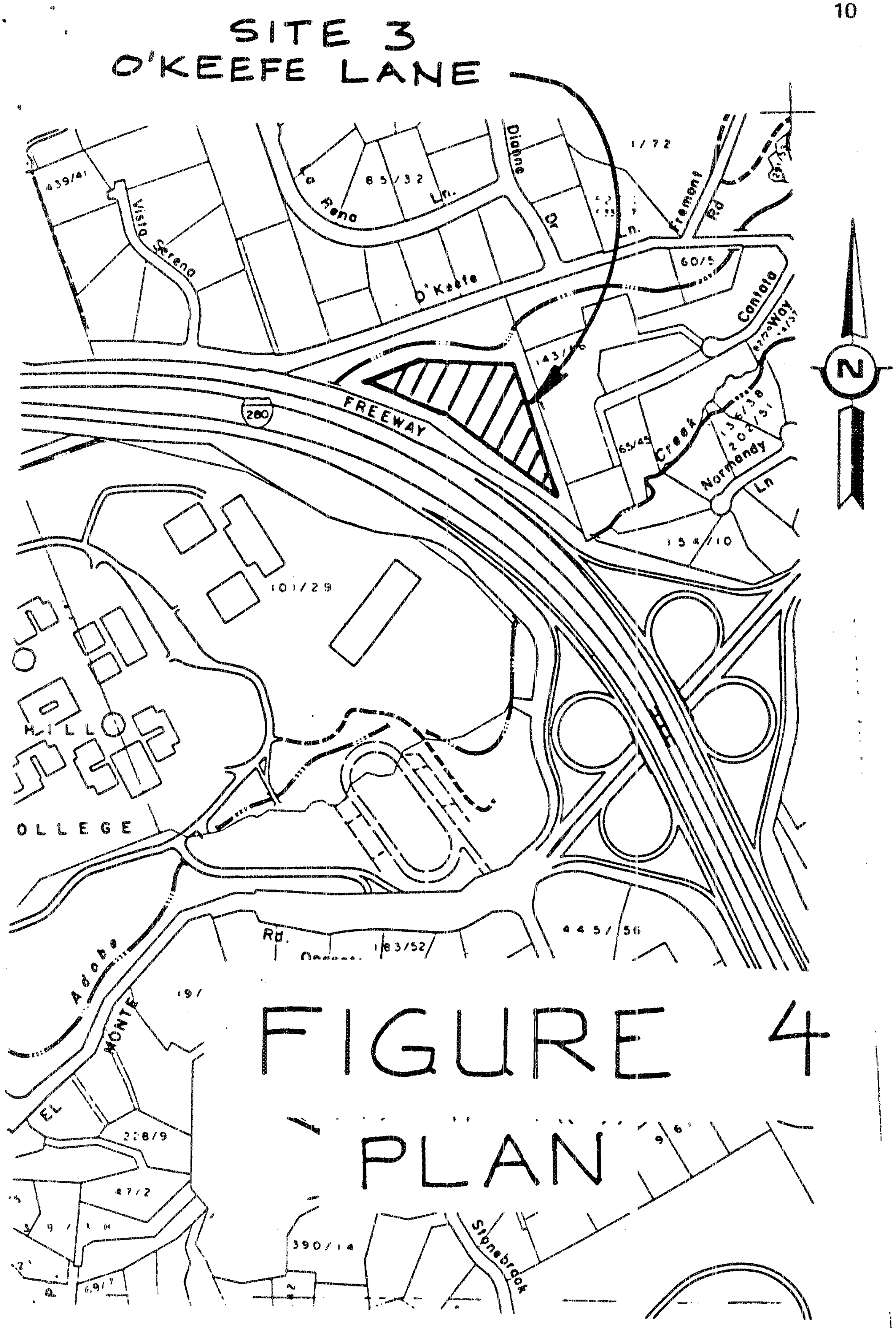


FIGURE 4

PLAN

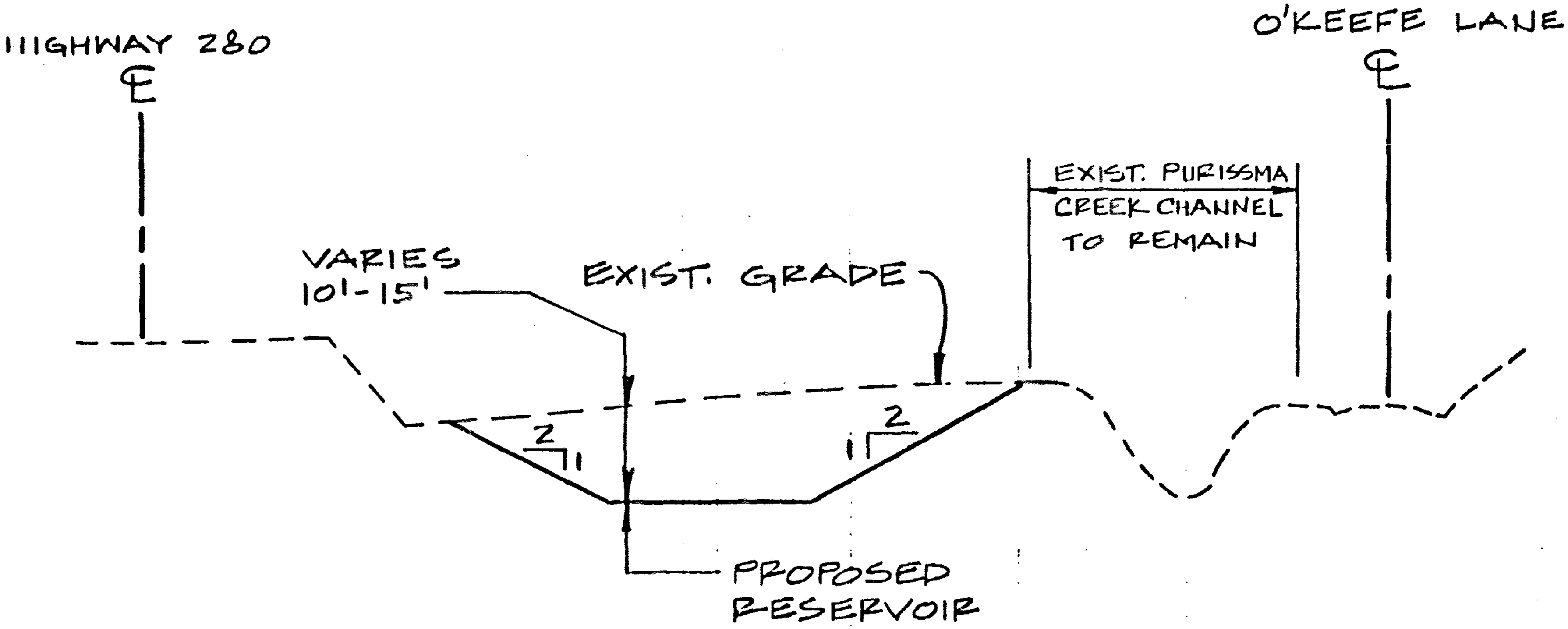


FIGURE 5

O'KEEF LANE
RESERVOIR CROSS-SECTION

NOTE:

1) CROSS-SECTION LOOKING UP STREAM

2) NOT TO SCALE

These parks are currently within the 1% flood zone. The Shoup Park Senior Citizens Center is only 7 foot above the creek invert, and subject to substantial flooding. Any flood control detention here would require relocation of the Center.

## Conclusion on Site 5 Feasibility

This is not a feasible site for flood control detention.

## Site 6. Foothill Expressway

This site is immediately upstream of Foothill Expressway on Adobe Creek.

An off-stream flood control reservoir would be possible here. As mentioned previously, off-stream storage is desirable for flood control. A reservoir could be excavated between Adobe Creek (leaving the creek intact) and the houses on the three properties involved (leaving the structures, tennis court, and portions of the existing back yards intact), with concrete diversion and outlet structures.

See Figures 6 and 7 for plan and cross-section.

Only 10 acre-feet could be stored here.

This site would require the purchase of 2 acres of property from 3 property owners on the west bank of Adobe Creek. Condemnation would probably be necessary to acquire the necessary right of way.

Construction access would be required for the removal of 1300 truck loads of excess material. The District's only access is two 15 foot wide ingress/egress easements which pass between the closely spaced houses on Old Oak Court. This would be a very significant impact to those living next to these easements.

## Conclusion on Site 6 Feasibility

A 10 acre-feet flood control reservoir could be constructed here, although it would probably face opposition from the affected property owners.

## Summary of Site Evaluations

Of the six proposed flood control reservoir sites, only the Hidden Villa (Lower Pasture) site and the Foothill Expressway site are feasible. These sites provide a total storage capacity of 80 acre-feet.

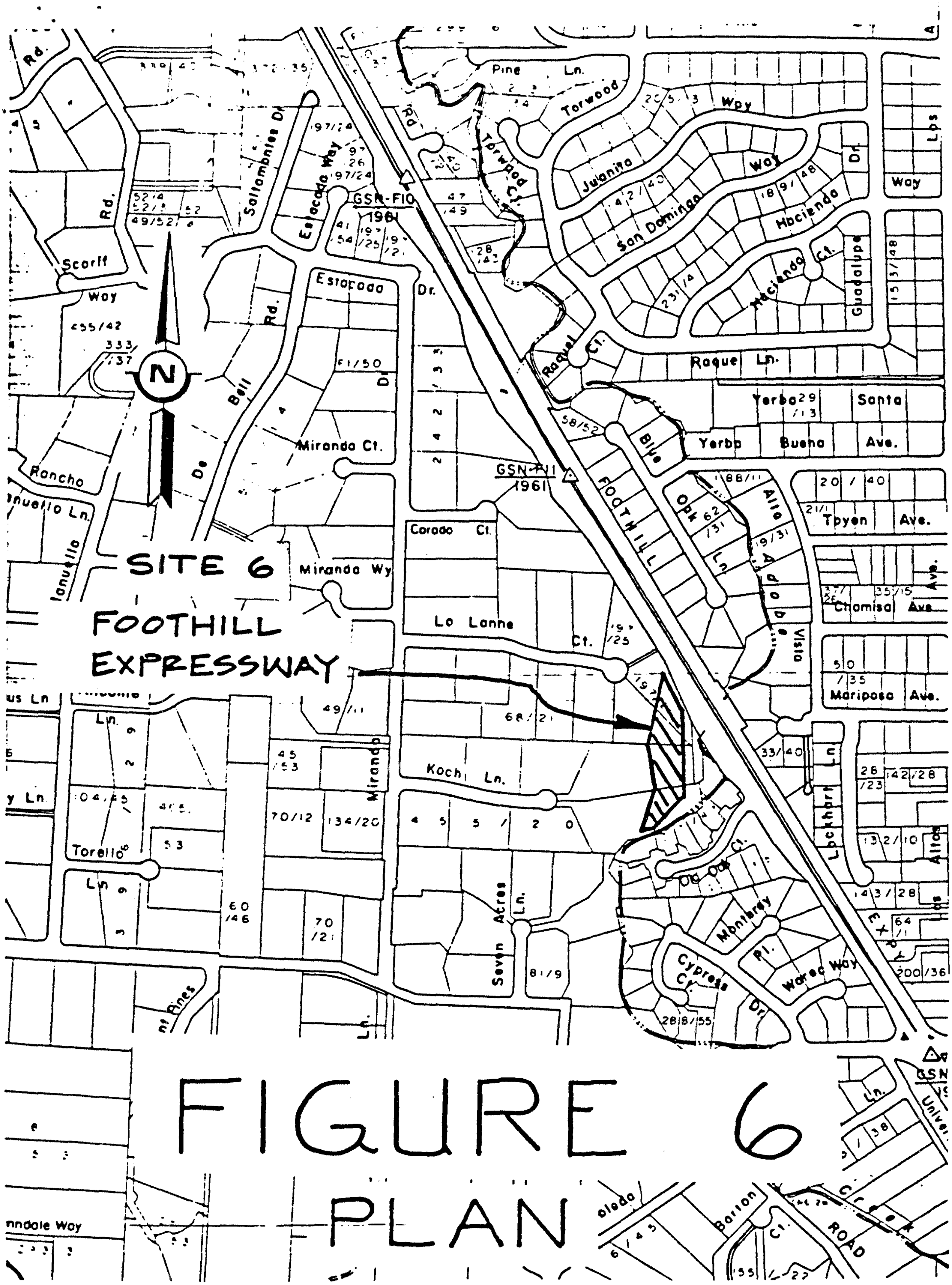


FIGURE 6

PLAN

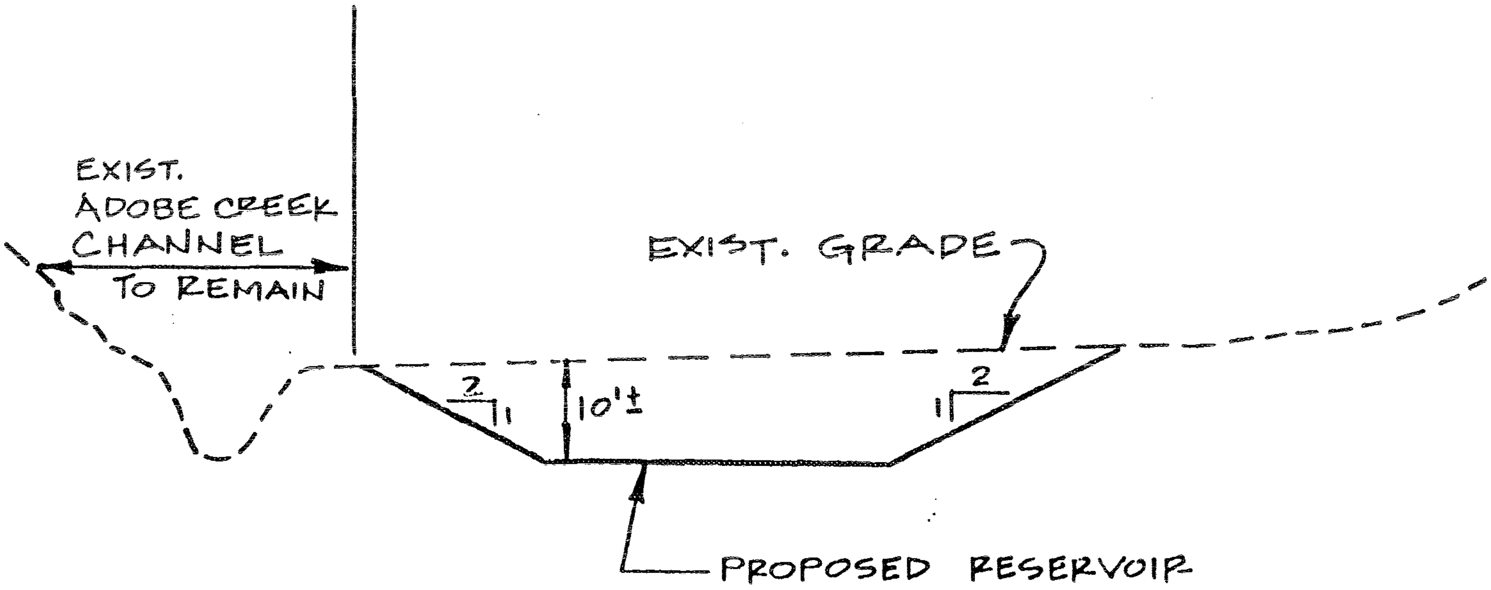


FIGURE 7

FOOTHILL EXPRESSWAY
RESERVOIR CROSS-SECTION

NOTE:

1) CROSS-SECTION LOOKING UPSTREAM
2) NOTE TO SCALE

See Table 1 for a summary of these sites and their features.

### Groundwater Percolation Capability

Joint flood control and groundwater percolation off-stream is contradictory. Flood control reservoirs must be kept empty for flood control. If flood waters flow through the reservoirs, the sediment which accumulates during a runoff event will block percolation.

Tom Iwamura, District geologist in the Groundwater Protection Division, has analyzed the percolation capacity of the six reservoir sites (see attached memorandum, Appendix 1).

The reservoir sites would have to be located between the groundwater basin boundary and "confined line" for percolation to occur. Sites would also need to be somewhat within this zone - ie, not on the boundary. All the reservoir sites are either at or above the basin boundary.

However, According to Tom Iwamura, the sites analyzed "would not result in meaningful artificial recharge enhancement".

Therefore, percolation at these sites is not feasible.

### Effects of Upstream Storage on the 1% Design Flow at Alma Street

The combined upstream storage of the reservoir sites at Hidden Villa-Lower Pasture and Foothill Expressway will reduce the 1% design flow by 600 cfs, to 2500 cfs.

### Flood Control Improvements - Miller Avenue to Charleston Road

With this design flow of 2500 cfs, the culverts at SPTC and Alma Street would have to be replaced and 6 foot high floodwalls would be installed below Alma Street.

### Impacts

### Construction Impacts

Noise, dust, and air pollution at the reservoir sites and on Adobe Creek at the SPTC and Alma Street culvert and between Miller Avenue and Charleston Road.

Both of these reservoir sites require the removal of a significant amount of excess material. At least 8100 truck trips to the Hidden Villa site, and 1300 truck trips to the Foothill Expressway site, would be required.

# TABLE I

## ADOBE CREEK PHASE IV
## COMPARATIVE SUMMARY OF 6 RESERVOIR SITES

| SITE | RIGHT OF WAY AVAILABLE | INDUCE FLOODING | STORAGE TYPE | STORAGE CAPACITY (acre-feet) | IS SITE FEASIBLE? | ESTIMATED DEVELOPMENT COST (millions) |
|---|---|---|---|---|---|---|
| 1. Hidden Villa-Lower Pasture | Yes, for $10 million | No | Off-stream | 70 | Yes | $11.5 |
| 2. Foothill College | No | N/A | Off-stream | N/A | No (a) | N/A |
| 3. O'Keefe Lane | No | N/A | Off-stream | N/A | No (a) | N/A |
| 4. El Retiro | No | Yes | On-stream | N/A | No (a) | N/A |
| 5. Shoup Park & Redwood Grove | No | Yes | On-stream | N/A | No (a) | N/A |
| 6. Foothill Expressway | Yes; Condemnation required | No | Off-stream | 10 | Yes | $2.5 |
| | | | Total Capacity Available | 80 | Total Cost (including floodwalls downstream & Alma St./SPTC culvert replacement) | $16 million |

(a) See Text

Increased turbidity in Adobe Creek below the reservoir sites.

Possible removal and replacement of existing mature trees along several hundred feet of Alma Street for shoofly construction on the SPTC culvert replacement.

Construction traffic into Adobe Creek from Alma Street and Charleston Road (to work on the floodwall installation and culvert replacement) would impact traffic on Alma Street and Charleston Road.

Temporary removal and replacement of existing backyard fences between Alma Street and Charleston Road would be necessary for floodwall installation. Backyard vegetation would also be affected.

The footbridge between Duncan Place and Creekside Way would be out of service for several months during channel construction.

**Long Term Impacts**

Floodwalls 6 foot high above ground between Charleston Road and Alma Street would have a visual impact on the neighborhood.

In order to preserve privacy in the neighboring yards, the fences next to the footbridge would have to be extended.

The three homeowners at the Foothill Expressway site would lose the use of portions of their properties. Installing a flood control detention basin would also visually impact the area.

The installation of a flood control reservoir at the Hidden Villa-Lower Pasture would visually impact the area, although it would be aesthetically graded and landscaped.

**Cost**

Right of way cost for these two reservoir sites is approximately $12 million. Construction costs would include: excavation of 140,000 cubic yards of excess material at the reservoir sites; installation of diversion and outlet structures at both reservoir sites; floodwall installation; and replacement of the SPTC and Alma Street culvert. Construction costs for the reservoirs and the channel work are $4 million.

The total cost of this alternative is $16 million.

**Conclusion**

The high cost and major environmental impacts combine to rule out this upstream storage alternative.

# PARTIAL CHANNEL REPLACEMENT WITH TRAPEZOIDAL & 17-FOOT U-FRAME ALTERNATIVE

## Background

District staff met with David Gilbarg (of the Liaison Committee) and Jeffrey Koseff of Stanford University on July 6 to discuss the channel hydraulics and project alternatives. They asked the District to investigate replacing a portion of the existing channel, instead of the whole channel.

Staff analyzed the replacement of portions of the existing channel with trapezoidal and U-frame channel sections. The aim was to minimize wall height and channel replacement.

## A. 60% Channel Replacement (Trial 1)

Under this scenario, the invert would be filled, which would steepen the slopes and eliminate the existing drops. The 17-foot U-frame would be installed from Station 212+09 to Station 229+16 (both of these modifications match those of the floodwall/17-foot U-frame alternative presented in the Project Alternative Report on June 21).

A typical trapezoidal section was assumed between Sta. 202+87 to Sta. 208+52, to match the existing cross-section at Sta. 202+87. The height of the trapezoid walls above the invert would be a maximum of 9.1 foot on the left bank and 8.7 foot on the right bank. 60% of the existing channel between Charleston Road and Alma Street is replaced in Trial 1.

This configuration ties in with the upstream and downstream existing trapezoidal channel, and minimizes the eddy losses seen in the existing channel.

## Results

A maximum wall height of 6.8 foot is required at Sta. 211+34. See the profile for Trial 1.

## Conclusion

A wall height of 6.8 foot is not acceptable. This is not a feasible alternative.

## B. 85% Channel replacement (Trial 2)

A second attempt to improve the water surface profile consisted of replacing 85% of the existing channel. This additional improvement amounts to replacing most of the existing channel.

### Configuration Changes

Between Sta. 199+07 to Sta. 202+87 and Sta. 208+52 to Sta. 210+94, trapezoidal channel sections to match the existing upstream and downstream channel sections are used.

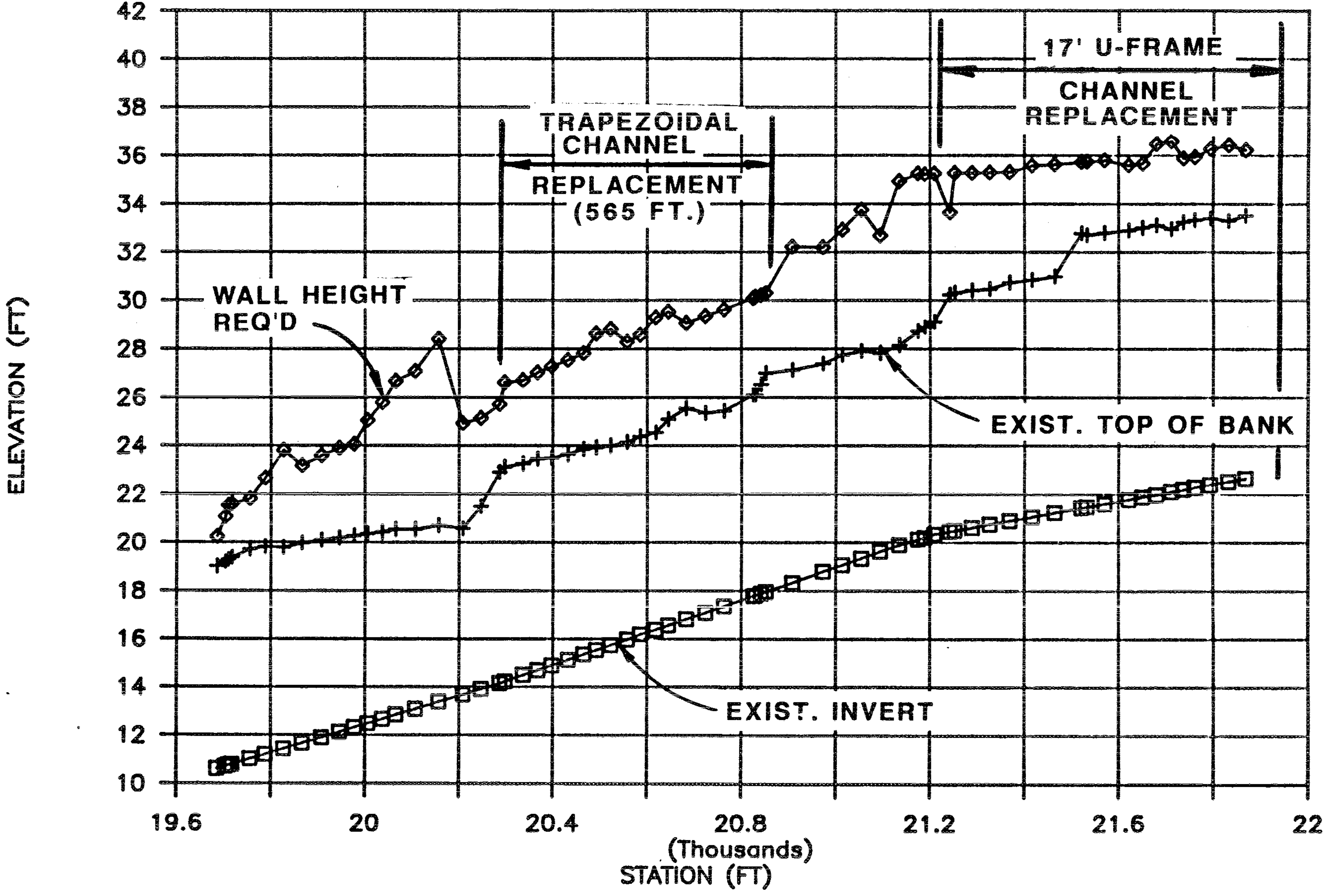
### Results

The maximum wall height for this alternative is 6.5 feet at Sta. 211+74. See the profile for Trial 2.

### Conclusion

The resulting water surface generated by this alternative is still well above existing ground, which would degrade local drainage. Construction and long term impacts, and cost, are essentially the same (if not worse) than those of the preferred alternative (20-foot to 17-foot U-frame channel).

Neither of these configurations are acceptable. Modification of the existing channel is not a feasible flood control alternative.

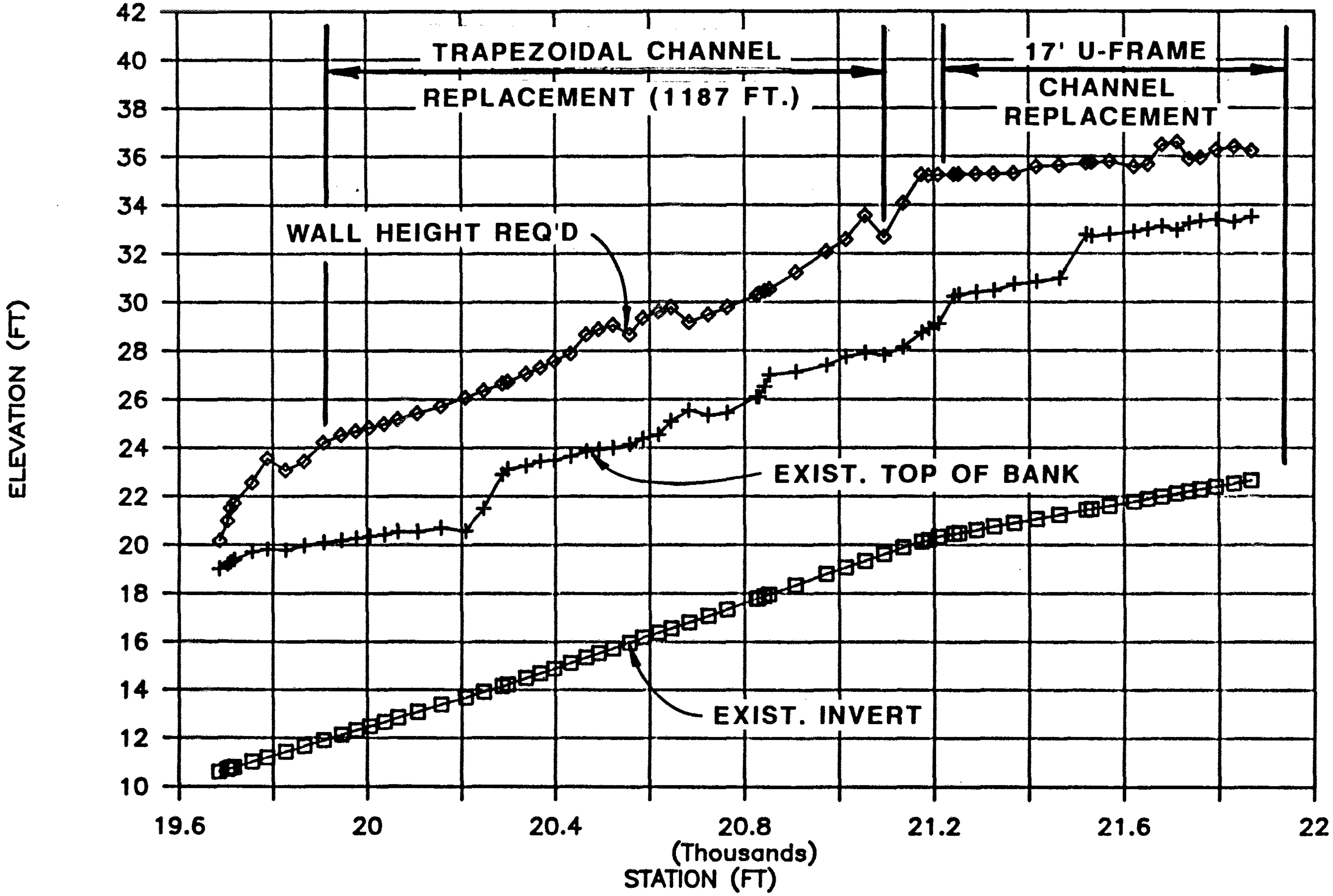


ADOBE CREEK MODIFIED TRAP & 17'U-FRAME

Q = 3100 CFS WALL HEIGHT REQUIRED (TRIAL 1)

# ADOBE CREEK MODIFIED TRAP & 17'U-FRAME

Q = 3100 CFS WALL HEIGHT REQUIRED (TRIAL 2)



## UPSTREAM STORAGE WITH DIVERSION ALTERNATIVE

### Background

At the June 21 Liaison Committee meeting, the District said that both upstream storage and diversion were not feasible flood control alternatives on Adobe Creek.

The District was asked to explore a combination of upstream storage and diversion acting together.

### Reservoir Sites

The four sites considered by the District in the Flood Control Alternative Analysis report were determined to be not feasible.

Of the six additional sites submitted for analysis by Libby Lucas, two sites were determined to be feasible, although not cost effective. These are the Hidden Villa (Lower Pasture) and the Foothill Expressway sites.

For this alternative, the Foothill Expressway site is not utilized due to access problems and the necessity to condemn property.

### Flow Reduction due to Reservoirs

At Alma Street, the Hidden Villa reservoir reduces the 1% design flow by 450 cfs, to 2650 cfs.

### Amount of Flow Diverted

With 6-foot floodwalls, the channel between Alma Street and Charleston Road will convey 2500 cfs.

200 cfs would have to be diverted at the Alta Mesa Cemetery to reduce the flow at Alma Street to 2500 cfs (as obtained by routing the flow downstream).

The Alma Street and SPTC culverts would be replaced also.

### Matadero Creek Configuration

From Adobe Creek to Alma Street, the configuration will be similar to that used in the June 21 report. The culvert sizes would be smaller (as an example, the Adobe Diversion culvert would be 5.5′ x 5.5′ instead of 13′ x 12′), the costs would be less, and the impacts somewhat less.

Between Alma Street and Highway 101, the flood control measures proposed in the 1988 Engineer's Report could be installed, except that the floodwalls and channel walls would be 6-foot high. The

District is trying to avoid the installation of walls this high on Adobe Creek or anywhere else.

**Impacts**

The impacts of installing these measures would be similar to those described separately under the diversion alternative (June 21 report), the upstream storage alternative (in this supplement), and under the floodwall/17-foot U-frame alternative (June 21 report) for the floodwalls.

**Costs**

The cost to install the Hidden Villa (Lower Pasture) reservoir is $11.5 million.

A diversion to Matadero Creek, the replacement of the SPTC and Alma Street culverts, and the installation of 6-foot floodwalls between Alma Street and Charleston Road would be required. The costs for this channel work would be $10 million beyond the costs of the work shown in the 1988 Matadero Creek Engineer's Report.

The total cost for this alternative would be $21.5 million more than the $21 million for the work proposed in the 1988 Engineer's Report, for a total cost of $42.5 million.

**Conclusion**

This alternative has a very high cost and major construction and long term impacts. This is not a feasible alternative when compared to the 20-foot to 17-foot U-frame channel.

## DIVERSION (REVISED FLOW AMOUNT) ALTERNATIVE

### Background

At the June 21 Liaison Committee meeting, the District said that diversion was not a feasible flood control alternative on Adobe Creek.

In order to answer questions raised at the meeting, the District agreed to look at the diversion of less flow from Adobe Creek. High floodwalls on Adobe Creek were required to contain the increased design flow in Adobe Creek.

### Amount of Flow Diverted

With 6-foot floodwalls, the channel between Alma Street and Charleston Road will convey 2500 cfs.

Therefore, the amount of flow diverted to Matadero Creek is 3100 cfs - 2500 cfs = 600 cfs.

The Alma Street and SPTC culverts would need to be replaced also.

### Matadero Creek Configuration

From Adobe Creek to Alma Street, the configuration will be similar to that used in the June 21 Flood Control Alternative Analysis report. The culvert sizes would be somewhat smaller (as an example, the Adobe Diversion culvert would be 8.5′ x 8.5′ instead of 13′ x 12′), the costs would be somewhat less, and the impacts marginally less.

Between Alma Street and Highway 101, the flood control measures proposed in the 1988 Engineer's Report could be installed, except that the floodwalls and channel walls would be 6-foot high or higher. The District is trying to avoid the installation of walls this high on Adobe Creek or anywhere else.

### Impacts

The impacts of installing these measures would be similar to those described separately under the diversion alternative (June 21 report), and to the floodwall/17-foot U-frame alternative (June 21 report) for the floodwalls.

### Costs

In addition to a diversion, the replacement of the SPTC and Alma Street culverts and the installation of 6-foot floodwalls between Alma Street and Charleston Road would be required. The costs for this work would be $13 million beyond the costs of the work shown in the 1988 Matadero Creek Engineer's Report.

The total cost for this alternative would be $13 million more than the $21 million for the work proposed in the 1988 Engineer's Report, for a total cost of $34 million.

## Conclusion

This alternative has a high cost and major construction and long term impacts. This is not a feasible alternative when compared to the 20-foot to 17-foot U-frame channel.

# APPENDIX 1

Libby Lucas
2 Sunwich Road
Rowayton, Conn. 06853

6/27-DEH w/a
IS
UMF

June 25, 1989

David E. Hook, A.C.E.
Design Division
Santa Clara Valley Water District
5750 Almaden Expressway, San Jose

3937 [illegible] 27 P1:12

Dear David,

In response to your request for the additional sites on Adobe Creek which should be considered as possible stormwater detention sites, please find enclosed the rough configuration of possibilities.

These possible retention sites will be reviewed by the liaison committee and you will hear from them as to which prospects they are in agreement on, but this may not be by July 7.

The feasibility of upstream retention presents a wide array of choices in both dedicated land and multi-purpose land already in the public domain. There is also private land that, due to environmental constraints, is retained as a natural floodplain to buffer development.

The area of prime consideration for flood retention is the ten acres, perhaps more, of the lower pasture of Duveneck Hidden Villa. This is the strip of pasture land that lies between Adobe Creek and Moody Road just north of the entrance road to Hidden Villa.

This is the best location for absorbing a cloud burst over the Black Mountain watershed. It would need contouring as a holding basin, but ideally could continue as pasture land for most months of the year. This is the only Hidden Villa property that is not covered by a conservation easement and a committee is presently looking at proposals for its future use.

Due to its prime location, its unencumbrance of structures, and the regional need for flood protection at this upstream location, it deserves prompt expert evaluation by your engineers. (enclosure A)

Downstream of this site the only sizeable property, the Adobe Creek Lodge and Gauthier Redwood Springs parcel has just been given final map approval. These two parcels are in floodplain, and last flooded over in 1983, and are under the jurisdiction of Los Altos Hills.

The next floodplain capability is the multi-purpose land use of the Foothill College parking lots, and football and baseball fields. This location was identified in your feasibility review of alternatives and holds strong potential. According to how it is bermed it could retain a peak flood flow,and let the water filter gradually back to Adobe Creek, or it could pass lesser sheet flows directly. The playing fields are in percolation terrain. (Enclosure B)

Just beyond #280 on Purissima Creek there is an old riding ring and field, surplus Cal Trans land that the Town of Los Altos Hills has acquired that is a good percolation area. Purissima flooded here in January of 1983 and this might be contoured for flood retention purposes if the Town is in agreement. This could continue to be used for open space and park preserve purposes but would delay a peak flood flow from reaching Adobe Creek

At the conjunction of Adobe and Purissima Creeks is low lying land zoned as a conservation easement for El Retiro that is a natural overflow parcel. Also Area C of El Retiro is permanently dedicated open space in an elbow of Adobe Creek that could be counted as peak flow retention acreage. (Enclosure D 1,2,3)

The City of Los Altos has required an 80 foot conservation setback on both sides of Adobe Creek for a good part of the sensitive area between O'Keefe Lane and the Los Altos parks of Redwood Grove and Shoup. This was an attempt to protect both parks which have buildings in the floodplain. Both parks however are candidates for passive flood retention capability.

The last low lying acreage that is suitable for conversion to a flood detention bowl, and which should probably be purchased with that intent, is on the west bank of Adobe at the Foothill Expressway underpass. This culvert is under-designed for the 100 year flood, and as the low east bank has been filled and developed, some overflow capability is needed in this location. (Enclosure F)

The stretch of Adobe Creek from Foothill Expressway to El Camino Real has no recent flooding, and the channel seems to have carried peak flows. The retention capacity at Alta Mesa Cemetary is limited due to expansion of the cemetary to most of the site.

The Terman School playing field is awkward to access over the footbridge at Hetch-Hetchy right-of-way, and offers little acreage due to development of site. Members of the liaison committee who are more familiar with this area of Palo Alto might have ideas on this stretch.

The 300 acre-foot retention capability might be achievable in these sites and even a 200 acre-foot flood retention capability would have benefits for all downstream residents, as well as retaining the beneficial uses of Adobe Creek.

To ensure that any concept of upstream retention flood control is viable however, the Duveneck Hidden Villa lower pasture parcel must be considered to be placed in the public domain for this purpose.

A very rough assessment of retention capability of parcels is:

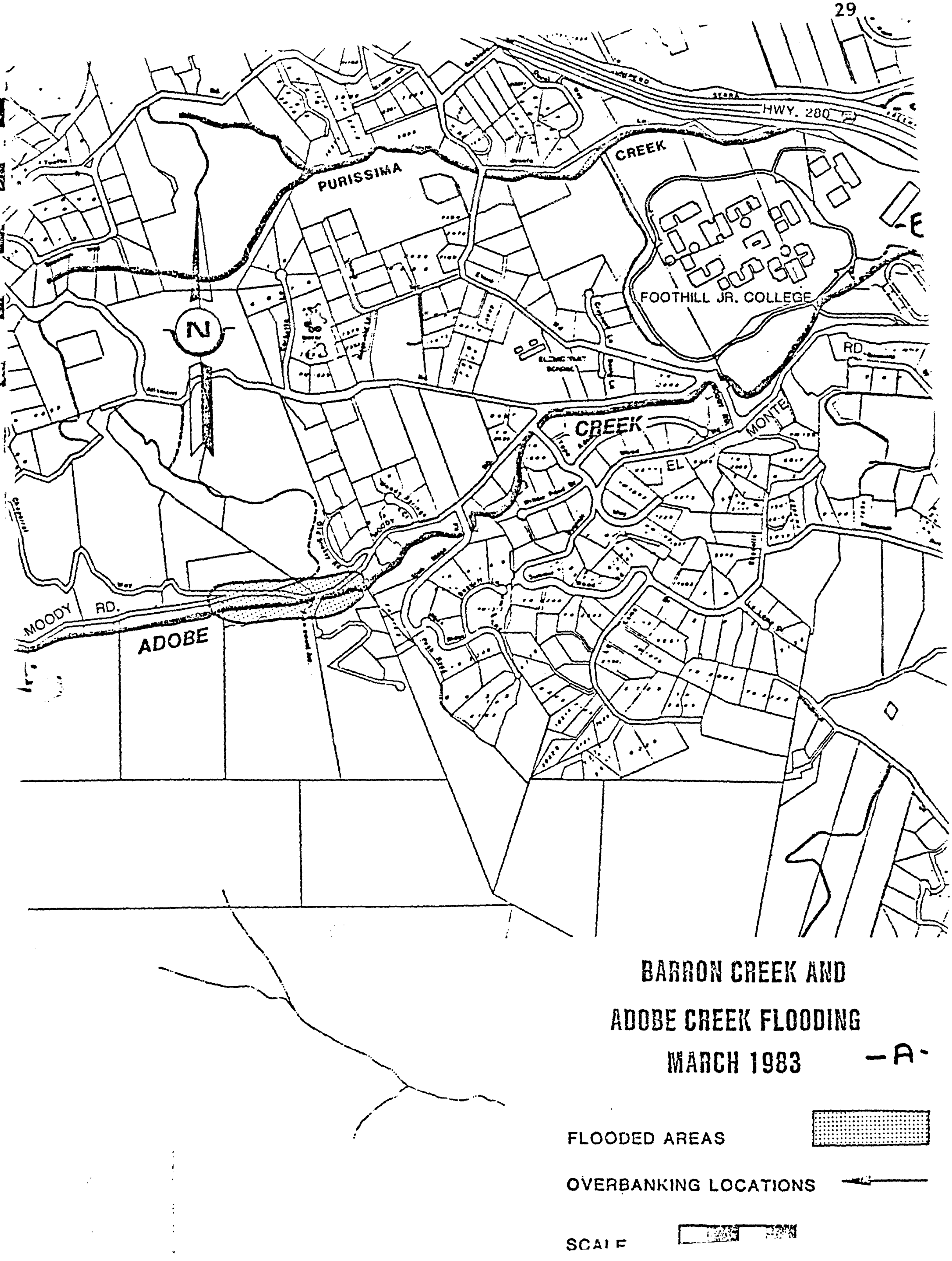
A. Duveneck lower pasture - 75 acre feet
B. Foothill College parking lots and playing fields - 75 acre feet
C. Los Altos Hills/Cal Trans Purissima fields - 40 acre feet
D. El Retiro dedicated conservation floodplain - 20 acre feet
E. Los Altos Redwood Grove & Shoup Park floodplain - 10 acre feet
F. Foothill Expressway underpass overflow basin - 30 acre feet.

Sincerely,

Libby Lucas

Libby Lucas
174 Yerba Santa Ave., Los Altos

P.S. Please incorporate the low-flow channel fish run capability in improved channel from San Francisco Bay up to El Camino Real.

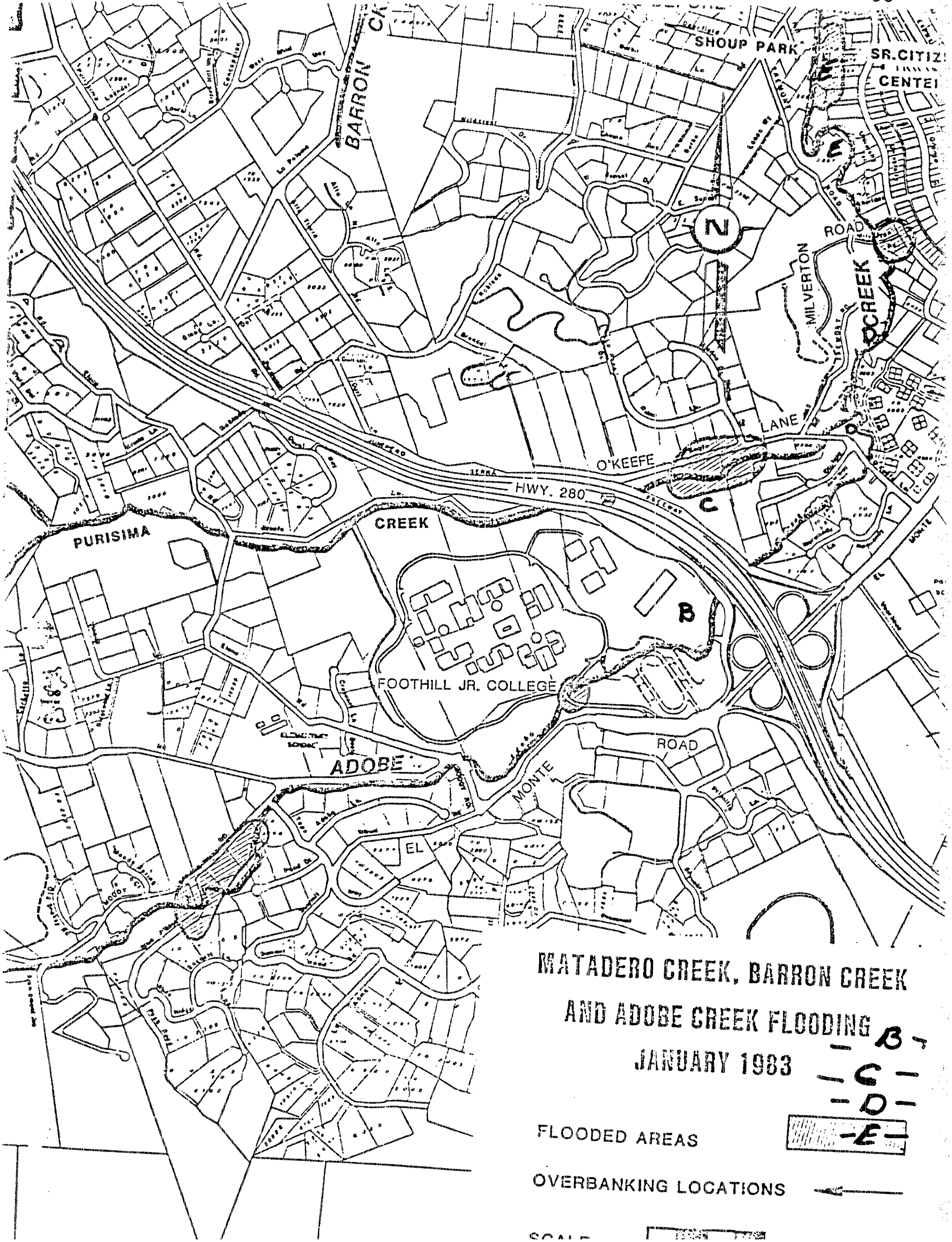


BARRON CREEK AND

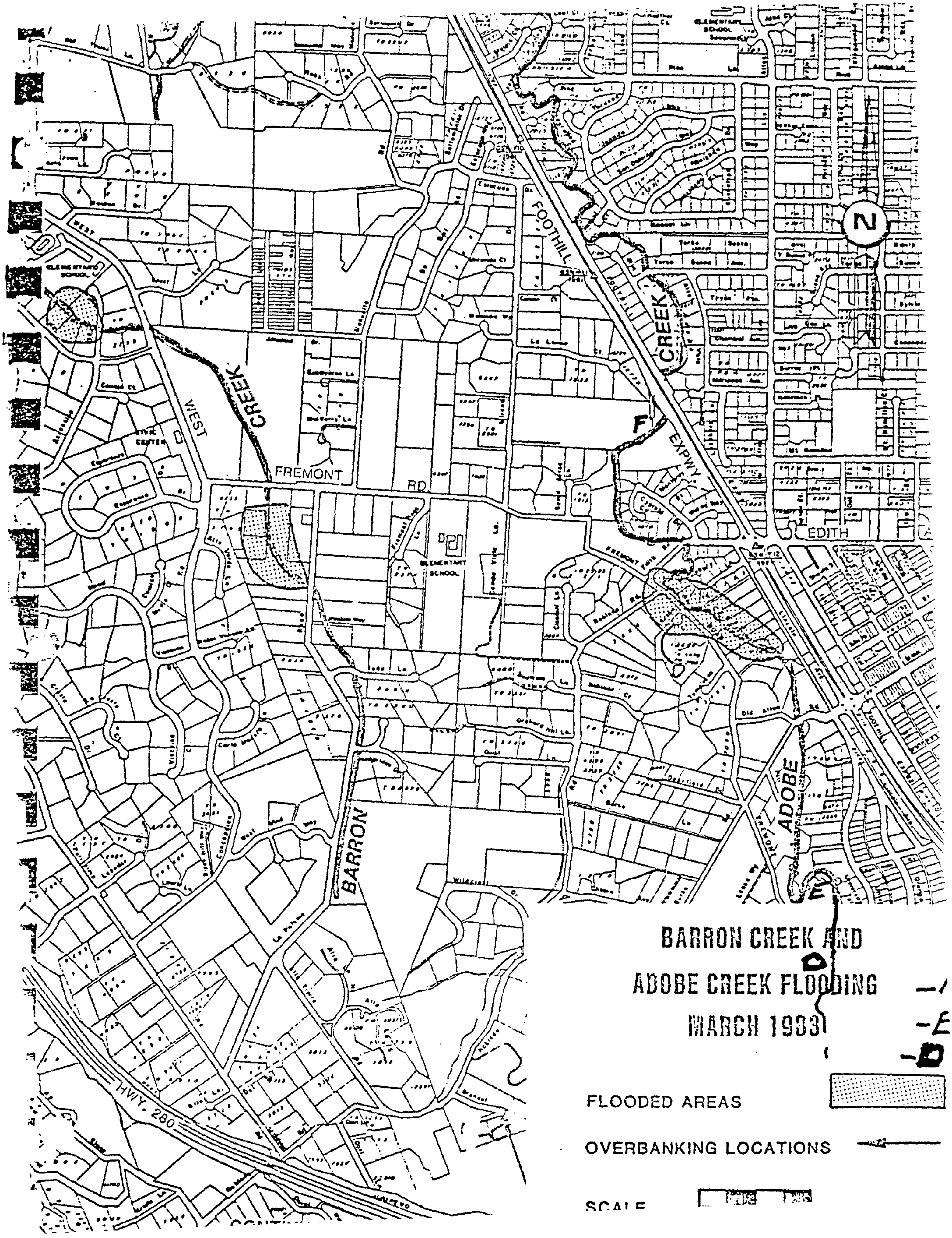
ADOBE CREEK FLOODING

MARCH 1983

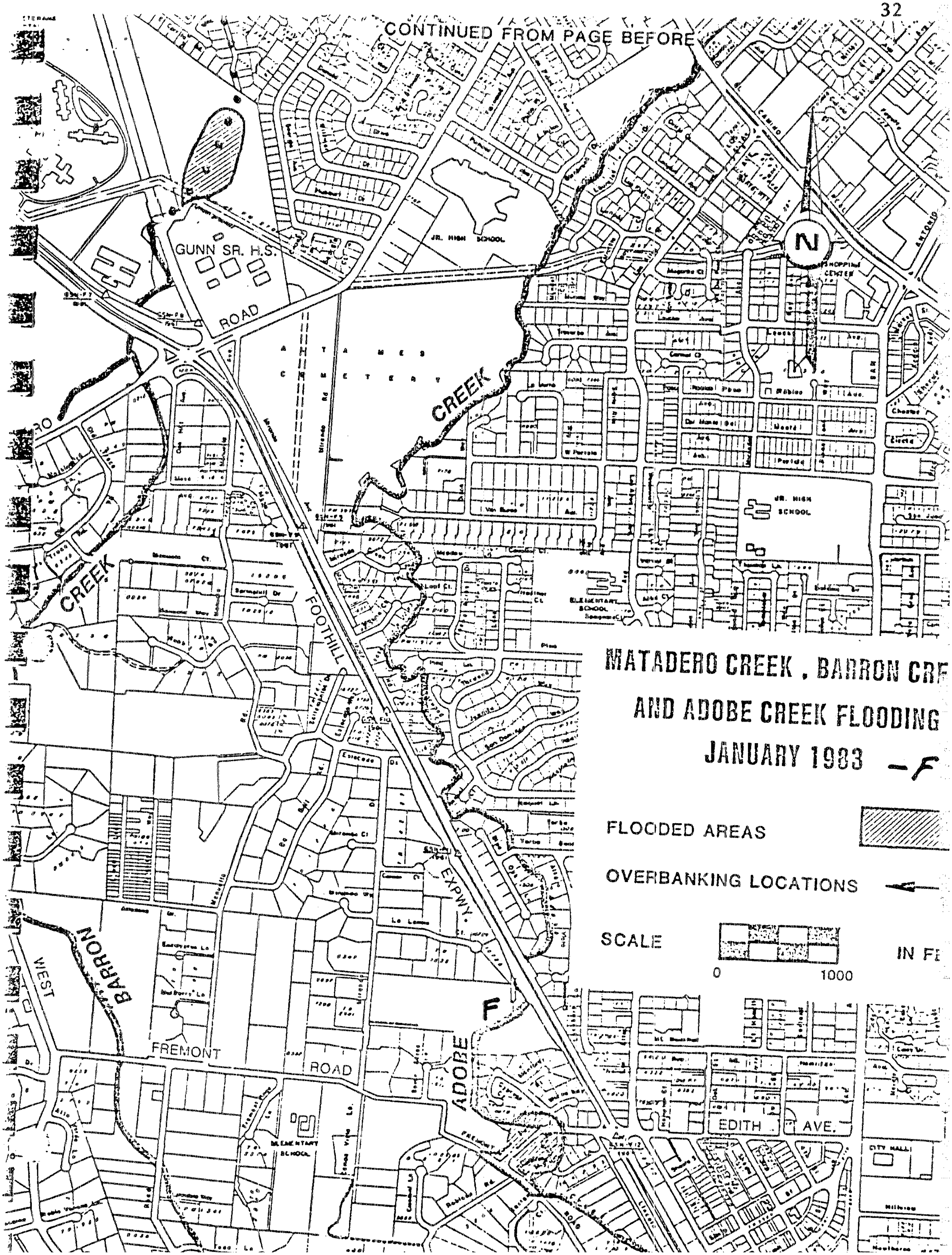
-A-



MATADERO CREEK, BARRON CREEK AND ADOBE CREEK FLOODING
JANUARY 1983



BARRON CREEK AND
ADOBE CREEK FLOODING
MARCH 1983



MATADERO CREEK , BARRON CRE

AND ADOBE CREEK FLOODING

JANUARY 1983

Santa Clara Valley Water District

# MEMORANDUM

FC 14 (02-20-87)

TO: Dave Hook

FROM: Tom Iwamura

SUBJECT: Assessment of Potential Recharge, Adobe Creek, Upstream of Foothills Expressway

DATE: July 18, 1989

This memorandum presents my assessment on the above subject which you had requested in your handwritten memorandum of June 28, 1989. Your request was based upon a letter inquiry from Libby Lucas of Los Altos to you dated June 25, 1989.

It is my assessment that any detention reservoir constructed along and adjacent to the reach of stream channels considered for Adobe Creek and its tributary, Purissima Creek, upstream of Foothill Expressway would not result in meaningful artificial recharge enhancement of the Santa Clara Valley Basin. These reaches in question are either outside (upstream) of the groundwater basin or at its boundary. Attached is a regional scale groundwater basin boundary map of the area. Also attached are two large scale maps showing the approximate basin boundary. Beneficial artificial recharge operations of the basin would have to be conducted downstream of the basin boundary and upstream of the "confined line" (labeled on the regional map).

Furthermore, the operation of a detention pond (or as a flood overflow reservoir) would not be compatible with efficient artificial recharge practices due to the high level of turbidity of large flow runoffs. High turbidity would reduce the rate of recharge by starting to seal the pond bottoms and sides. Such turbidity does not significantly affect the stream channels as the channels are erosionally scoured by the high flows and the sealing effects do not accumulate.

Please contact me should you have any questions.

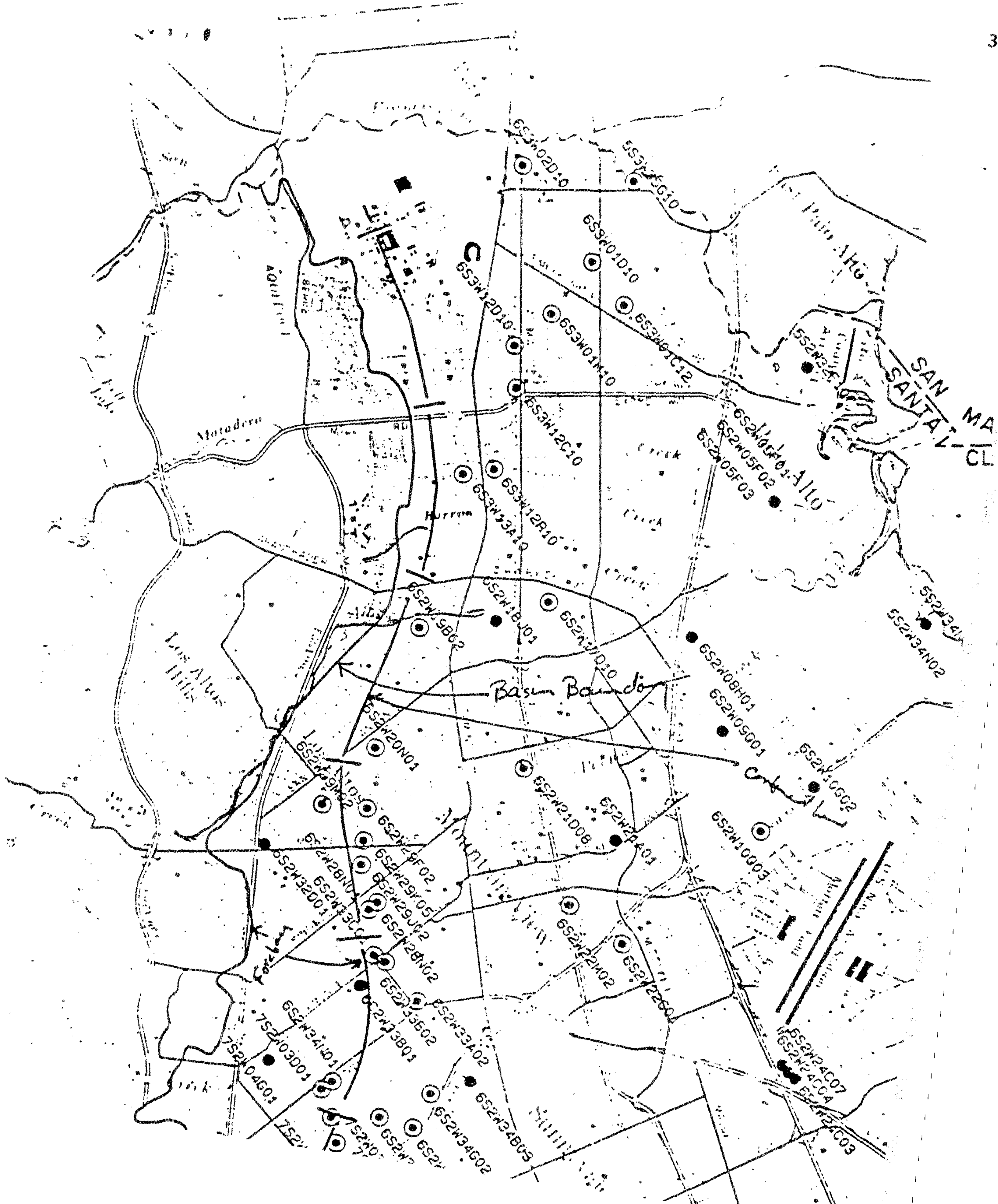
Tom Iwamura

Engineering Geologist
Water Contamination Control Division

Attachment

cc: D. Chesterman
T. Iwamura

TII:kj


6S3W02D10
5S3W35G10
6S3W01D10
6S3W01C12
6S3W12D10
6S3W01M10
6S3W12C10
6S3W12R10
6S3W13A10
6S2W06F01
6S2W05F02
6S2W05F03
5S2W33
Palo Alto
SAN MA
SANTA CL
Alto
Matadero Creek
Creek
Creek
Los Altos Hills
6S2W15B02
6S2W18J01
6S2W17D10
Basin Boundary
6S2W08H01
6S2W09G01
5S2W34
5S2W34N02
6S2W20N01
6S2W19M02
Los Altos
6S2W21D08
6S2W22A01
6S2W10G02
Contact
6S2W10G03
6S2W28F02
6S2W32D01
6S2W28N0
6S2W29K05
6S2W29J02
6S2W33C0
6S2W28N02
6S2W22M02
6S2W22C0
6S2W33G02
6S2W33A02
6S2W33B01
6S2W34N01
7S2W03D01
7S2W04G01
7S2
7S2W0
6S2W
6S2
6S2W34G02
6S2W34B03
6S2W24C07
6S2W24C04
6S2W24C03
I
II

# CITY OF PALO ALTO
## MEMORANDUM

January 22, 1990

TO: Rick Smelser, Public Works Department

FROM: Keith Boyle, Planning Department

SUBJECT: Planning Response to Adobe Creek Flood Control EIR,
Comments due to Santa Clara Water District by January 26, 1990

The Planning Department concerns are primarily focused on impacts to the rear yards of the private residents. Although construction noise and dust impacts are only temporary, measures should be taken to limit these impacts as much as possible. Contractors shall be subject to the City's Noise Ordinance (Section 9.10.060 of the Palo Alto Municipal Code) including limited operating hours. Additionally, dust control measures should implemented, including two daily waterings of exposed earth surfaces and daily street and dirt haul route cleaning. This dust control program should be monitored by the Public Works Department with the contractor being financially responsible for controlling dust nuisances originating from the contractor's operations either inside or outside of the right-of-way.

Planning Staff is also concerned with the removal of a significant number of mature trees from the creekside area as identified in Table 3. These trees and other existing vegetation significantly soften the visual impacts of the concrete drainage ditch. Staff does not feel that the proposal to reduce visual impacts by installing a new six-foot-tall fence around the flood walls is adequate. The EIR should identify ways to save as many significant trees as possible. Those trees that must be removed which have diameters of 6 inches or more should be replaced with similar trees that are at least 48-inch box specimen trees. Additional landscaping including shrubs and ground cover should be installed to further soften the visual impact.

KB/lc

cc: Nancy Lytle, Zoning Administrator
Carol Jansen, Chief Planning Official
Ken Schreiber, Director of Planning & Community Environment

STATE OF CALIFORNIA—THE RESOURCES AGENCY GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
P.O. BOX 944209
SACRAMENTO, CALIFORNIA 95814-2090
(916) 445-3531

January 9, 1990

Dr. Bernie Goldner
Santa Clara Valley Water District
5150 Almaden Expressway
San Jose, CA 95118

3310 '90 JAN 12 P1:42

Dear Dr. Goldner:

Draft Environmental Impact Report (DEIR) for Adobe Creek Channel Improvements, SCH 89040420, Santa Clara County

Department of Fish and Game personnel have reviewed the proposed Adobe Creek DEIR for a Santa Clara County Water District project which would widen and heighten the existing concrete-lined channel from Charleston Road to El Camino Real. For the reasons indicated below, we recommend against certification of the DEIR.

Adobe Creek is not presently recognized as a creek supporting a significant migratory salmonid fishery. However, the narrow riparian corridor provides habitat for both residential and migratory species of birds, mammals, and other wildlife species. Loss of this habitat would force wildlife to utilize adjacent habitats that are currently at their carrying capacity. Thus, encroachment upon these areas would result in loss of those wildlife populations utilizing riparian areas which would be negatively impacted. The Department views this loss of riparian vegetative communities and wildlife as a significant adverse impact.

(1) The DEIR should address measures to mitigate for the loss of riparian associated species such as redwoods, alders, and willows, as well as understory species. (2) Vegetative losses above the Southern Pacific Railroad culvert should also be enumerated and mitigated. (3) The DEIR is inadequately detailed for compliance with California Environmental Quality Act requirements related to requisite specificity regarding impact disclosure and precise description of mitigation measures. It is the policy of the Department to oppose the authorization of projects which would result in the net loss of either wetland acreage or wetland habitat values. (4) Consequently, we recommend that, prior to certification of the DEIR, the project sponsor devise a compensation plan which, when implemented, would assure that the project does not result in a net loss of either wetland acreage or wetland habitat values. (5) This plan should be prepared as a focused Supplemental DEIR; circulated for public review and comment; and, if adequate, to achieve the goal of no net loss of both wetland acreage and wetland habitat values, incorporated as an enforceable condition of certification of environmental documentation per the project.

The project design includes a "U" shaped concrete-lined channel without a recognizable low-flow channel.(6) We recommend the design be modified to provide a low-flow channel, as well as providing for migratory fish passage.(7) We recommend that this design modification be incorporated into the previously recommended focused Supplemental DEIR.

Before project implementation, a streambed alteration agreement from our Department must be obtained. This should not be requested until all other applicable permits have been obtained.

In summary, and for those reasons previously indicated, we recommend against the certification of the subject DEIR at this time. However, given the preparation of a wetland compensation plan and incorporation of our recommended design modification, we would remove our objection to certification of this DEIR. Department personnel are available to assist in the development of compensation strategies as well as incorporation of our recommended design modification.

If you have any questions, please call Mr. Dean Marston, Fishery Biologist, at (408) 663-0939; or Mr. Carl Wilcox, Associate Wildlife Biologist, at (707) 944-5525.

Sincerely,

Pete Bontadelli
Director

cc: Resources Agency
State Clearinghouse

**State of California** **Business, Transportation and Housing Agency**

# Memorandum

To : Loreen McMahon
State Clearinghouse
1400 10th Street, Room 121
Sacramento, CA 95814

Date : January 2, 1989

File No.: SCL-82-PM22.67
SCH#89040420
SCL082057

From : **DEPARTMENT OF TRANSPORTATION**
**Transportation Planning Branch-District 4**

Subject: DEIR: Adobe Creek Flood Control Project (Flood control channel improvements)

The California Department of Transportation (Caltrans) has reviewed the above referenced document and has the following comments:

The environmental document fails to address the impacts of this project on Caltrain rail service. As we stated in our response to the Notice of Preparation for this document (May 10, 1989), the delays caused by the track relocation may result in a loss of ridership for Caltrain. The Environmental Impact Report must address the impact of this project on Caltrain and propose mitigation for the impacts.

We appreciate the opportunity to work with you on this project and wish to continue close correspondence on it. We also look forward to reviewing the FEIR prior to the approval of this project. Please send a copy to the undersigned contact person for this agency at the following address:

WADE GREENE
District CEQA Coordinator
Caltrans Dist 4
P.O. BOX 7310
San Francisco, CA. 94120

RECEIVED
[illegible] 4 1990

Should you have any questions regarding these comments, please contact Terry Grindall of my staff at (415) 557-7187.

Sincerely yours,

BURCH C. BACHTOLD
District Director

By Wade Greene

WADE GREENE
District CEQA Coordinator

cc: Gary Adams, District ATSD Coordinator
Susan Pultz, MTC
Sally Germain, ABAG

[illegible]
1/26 BNG w/c
SNW

**Date:** January 25, 1990

RECEIVED
JAN 26 1990

**From:** David Gilbarg, 209 Creekside Drive, Palo Alto, CA 94306

**To:** Santa Clara Valley Water District

**Subject:** Comments on Draft EIR for the Adobe Creek Channel

I wish to call attention to serious risks in the Preferred Alternative for the Adobe Creek Channel and to urge that other alternatives be given greater consideration.

The proposed design is based on various hydraulic assumptions, including clear water flow, a Manning roughness coefficient $n = .015$ and downstream supercritical flow. The flooding of the similarly designed Corte Madera Creek in 1982 and 1986 shows that these assumptions may break down in larger flood flows, causing higher surface elevations and consequent flooding. Specifically, the Corte Madera Creek Channel design assumed a Manning roughness $n = .014$ whereas the composite roughness due to sediment in the channel was at least .03, causing subcritical flow, higher than predicted flood elevations and then flooding. This phenomenon and debris obstruction, which obviously can also affect the hydraulics, are to be expected in a major flood. (For details and a fuller discussion see the attached article, "Rethinking flood-control channel design", by P. Williams in Civil Engineering, January 1990.)

The design of the proposed Adobe Creek 20' U-frame channel assumes a Manning $n = .015$ and channel capacity of 3100 cfs. Standard conveyance calculations show that the creek will overflow the free board and there will be flooding if the effective $n = .024$. This is a smaller increase in $n$ than in the Corte Madera Creek flood where (as noted above) $n$ reached .03.

The existing Adobe Creek channel has not flooded in the Alma to Charleston reach since its construction in the 50's and, with improvement of the SP culvert, will protect against a 2% flood but presumably not against the larger but rarer 1% flood. Tearing up the present channel and replacing it with the proposed alternative will cause significant impact and as we have seen will still carry the risk of flooding. A more rational solution to the problem of rare flood would be a system of temporary retention which would be activated only in the rare case of large flooding. Admittedly, there are problems including cost in such a program, but this approach would be less risky and less damaging in the long term.

David Gilbarg

STANFORD UNIVERSITY • OFFICE MEMORANDUM

[illegible]
flood-control scheme
requires a multiobjective
approach.

**PHILIP B. WILLIAMS**

# RETHINKING FLOOD-CONTROL CHANNEL DESIGN

On Jan. 4, 1982, the 10-year-old Corte Madera Creek flood-control channel in Marin County, Calif. faced its first significant test. As the rains fell, record flood flows occurred upstream from the channel. Most of the over-bank floodwater was diverted from the project, leaving only about 5,000 cfs—equivalent to the 20-year flood—to enter the channel. But the waters overtopped the channel's banks, even though the flow was well below design capacity.

The Corte Madera incident illustrates the problems of traditional flood-control channel design. Until the last decade, the standard method of flood control was channelization—converting a natural stream to a uniform channel cross section. But this single-purpose approach is under increasing scrutiny from both engineers and the public. Engineers are becoming concerned that traditional designs may not work as intended and fail during floods. The public, meanwhile, is becoming dissatisfied with the environmental destruction normally caused by single-purpose design.

Combined with reduced federal funding for flood-control projects, this reassessment is pushing flood-control engineers to explore new design options that reflect multiobjective stream corridor planning.

Traditional hydraulic engineering methods remain largely unchanged from 30 to 40 years ago. Used by every civil engineer, they are largely based on data from flume experiments and measurements of the hydraulics of straight, uniform canals. These methods are then applied in the modification of natural stream systems.

But streams aren't flumes. They aren't straight. They have varying and interacting flows, changing channel configurations and sediment loads, and differing bed and bank characteristics. Flood-control engineers try to achieve safe designs by simplifying a stream to replicate the hydraulics of the laboratory flume, but this may lead to a false sense of security.

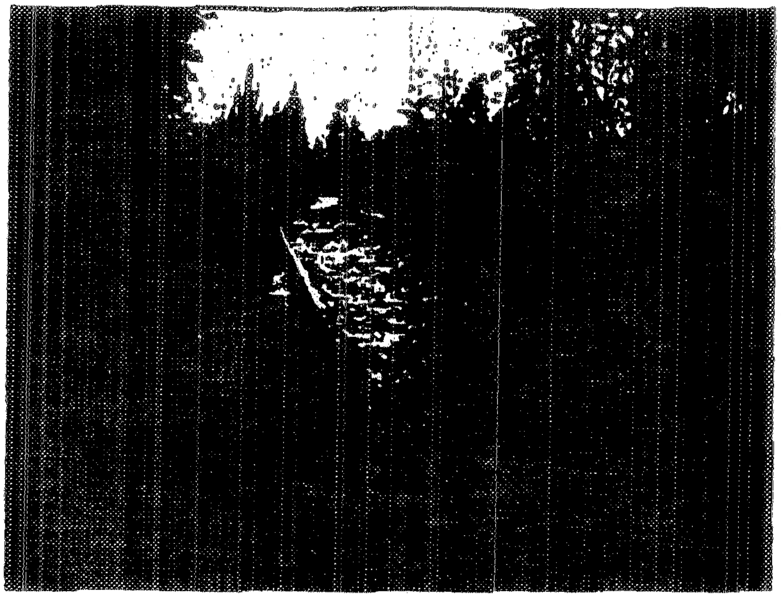
## COMMON PROBLEMS

The growth of suburbia over the last 30 years has meant a corresponding growth in the construction of traditionally designed flood-control channels. Although few channels have yet had to convey floods approaching design flows, common problems are emerging that can in some circumstances reduce their effectiveness, leading to flooding of areas considered safe.

These problems arise from the notion that channel construction is a technical "fix," rather than part of a damage-reduction strategy that can encompass an entire watershed and stream corridor. This narrow focus means that important factors could be misjudged or overlooked:

- The effect of sediment. Traditional design methods usually assume clear-water hydraulics that discount the way in which sediment can affect the performance of a channel. Sedimentation was ignored in the 1959 construction of the San Lorenzo River project in Santa Cruz, Calif. The design grade was 5 ft lower than the natural channel and below sea level at the mouth of the river, creating a sediment trap. During the first few years of operation, even small flows caused the channel to silt in, reducing the capacity to about the 30-year flood. Instead of the few thousand dollars a year in maintenance costs estimated by the designers, the city was faced with prohibitive sediment-removal costs of more than $1 million a year.
- Flow resistance. Flow resistance is often underestimated because the selection of the Manning n hydraulic roughness is, at best, a matter of engineering judgment. The lack of monitoring and analysis of the actual performance of flood-control channels makes it difficult to assess how accurate these values are for large floods. There are many factors affecting flow resistance, and Manning's n is a black box combining them all. Most engineers focus almost exclusively on bank vegetation as the

0885-7024/90/0001-0057/$01.00 + .15 per page



**With supercritical flow, the Corte Madera Creek does not overtop its banks. But in subcritical flow during the 1982 flood, it did.**

major factor in Manning's n simply because it is most visible and controllable, ignoring other processes that may be dominant. The emphasis may then be on clearing vegetation, even though certain factors, such as sediment transport and bed forms, may have more of an effect on flow resistance.

- Supercritical flow. Supercritical flow may not occur. Assuming traditional design methods, the minimum right-of-way width and maximum bank-erosion protection can be achieved by putting the stream in a concrete box and inducing high-velocity shallow supercritical flow. Achieving supercritical flow requires low bed and bank roughness. For clear water in straight concrete channels, Manning's roughness is about 0.015. But every large flood carries appreciable amounts of bed load, and this can significantly increase the composite channel roughness, causing the flow to shift back to deeper, slower-moving subcritical flows, sometimes leading to over-bank flooding. This is what occurred at Corte Madera Creek.
- Debris obstruction. Large floods can generate debris, which can catch on bridge pilings or culverts and substantially increase flood elevations. Actual 100-year flood profiles through urban areas can resemble a staircase of backwater pools behind obstructed bridges rather than a uniformly sloping water surface.

In traditional flood-control design, debris blocking effects are frequently underestimated. This focuses too much attention on achieving a desired uniform flow-channel conveyance, when the most cost-effective approach may be the replacement of bridges or improved emergency maintenance procedures to remove debris.

- Channel boundaries. The hydraulics of many flood-control channels are calculated with the assumption that beds and banks do not erode or fill with sediment during big floods. But where streams flow in alluvium and are unlined, erosion and sediment accumulation can affect flood risk. The 1982 flood on the San Lorenzo River, for example, should have overtopped the levees, according to standard HEC-2 rigid boundary analysis. But by the time of the flood peak, water surface elevations were several feet lower than predicted because the bed was considerably scoured.

Unfortunately, predicting the amount of scour and deposition is complex, but discounting the beneficial effects of scour during flood flows can lead to unnecessary, costly measures.

- Maintenance requirements. Textbook hydraulic design tends to impose rigid requirements for maintaining the channel cross section and allowable vegetation. Maintenance crews are then forced to clear the channel, using costly methods harmful to the environment, to make the channel conform to old design office estimates.

In some instances, maintenance procedures may actually increase flood risks. According to design requirements, the bed and banks of a trapezoidal earth channel, for example, must be continuously cleared of vegetation to minimize roughness. But little research has been carried out on the actual roughness effects of vegetation on flood flows. There is typically no differentiation made between the relative effects of in-channel, bank and floodplain vegetation.

Maintenance is usually underfunded and unglamorous—and channels are not cleared every year. The flat exposed bed of a trapezoidal channel is the perfect growing medium for certain aquatic plants, which could choke the channel within two years, substantially reducing its capacity. But sometimes, if the channel is left completely unmaintained for a longer period, riparian vegetation on the banks will eventually shade out the channel, increasing its flow capacity again. Some channels are cleared indiscriminately only every few years and are thereby managed at their minimum conveyance rather than maximum.

## THE NEW APPROACH

Most importantly, the new approach to flood-control channel design considers flood-hazard reduction as just one component of a multiobjective riparian corridor management strategy. This strategy also includes and may give equal weight to the protection and enhancement of the riparian environment and the improvement of its esthetics.

The new emphasis is on continual long-term management of a creek corridor. Management entails a continuum of periodic interventions in the natural system that ranges from modification to maintenance, rather than the traditional two-step sequence of construction followed by maintenance. It requires the establishment of a monitoring and feedback mechanism that allows for the prioritization of damage reduction—some of which may be nonstructural—and the identification of failure mechanisms. Within this context, the need for channel modification to reduce flood damage in the riparian corridor can be clearly established.

The corridor—a wider area that includes trees, wetlands and public-access paths—becomes the design focus. The successful development of a multiobjective design requires an understanding of the complex physical behavior of natural streams and how the stream interacts with its ecosystem.

Although fluvial geomorphologists are getting a better idea of how streams behave, the results of their research are not routinely used in flood-control design. What is needed is a synthesis of hydraulics engineering and fluvial geomorphology, which would encourage designers to work with natural processes rather than combat them. This synthesis could lead to substantial savings, because the resulting design would anticipate sediment movement, stream meandering and bank erosion. Concepts, such as the equilibrium stream profile, regime equations relating channel geometry to flow parameters and the formation of floodplain terraces, can be used in developing new designs for modified channels.

Incorporating fluvial geomorphology in a multiobjective scheme allows the different goals to complement each other. This aided the completion of a "two-stage" flow-channel design concept developed in Europe and the U.S., a design that is now being used in the construction of the Wildcat Creek project in Contra Costa County, Calif. The design called for the construction of an artificial floodplain terrace and the excavation of a low-flow channel (sized to the equilibrium bank full flood). The terrace provides space for a walking trail, and the low-flow channel allows fish and sediment to move downstream. Planting riparian trees on the bank shades out the channel, which prevents vegetation encroachment, minimizes maintenance, improves water quality and creates a continuous corridor for wildlife. Riparian vegetation can also slow bank erosion.

Anticipating the natural behavior of the stream can also permit a shift to less-destructive methods of maintenance, methods that are based on performance rather than on prescriptive criteria determined by the engineer at the time of design. Meanwhile, a program for monitoring actual flood flows and elevations can assist in deciding where and whether channel capacity needs to be increased, bridges replaced or floodwalls constructed. Such attention to detail would help avoid the need to embark on a costly, large-scale channelization project.

Increasing public interest in creek protection is now accompanied by a demand for restoring the environmental characteristics of previously channeled streams. Environmental and esthetic improvements can usually be made, but the options are limited by available rights of way. For new projects, right-of-way width requirements are often cited as the major impediment to selecting a multiobjective design over a traditional flood-control channel. However, taking a more realistic assessment of actual flow resistance, the role of sediment and long-term maintenance of traditional design approaches may mean that there is little difference between the two alternatives.

I hope this means that hydraulics engineers will no longer be seen by local residents as advocates of environmental destruction, turning natural streams into storm sewers. Instead, they could be seen as guardians of urban creeks—helping to preserve them and protect them against flood damage. ▽

## ROUGH TIMES

Many residents of California's wealthy Marin County were willing to live with flooding of the Corte Madera Creek if it meant that the natural stream corridor could be left intact. So when a concrete-channel flood-control project was proposed, they rallied against it. But in spite of local opposition, Unit 3 of the U.S. Army Corps of Engineers' Corte Madera Creek flood-control project was completed in 1972. Its design was based on the mistaken assumption that the standard project flood could be safely conveyed with a low Manning's roughness (0.014) that would allow supercritical flow to occur. What later occurred illustrates the problems of a single-purpose approach to designing a flood-control channel.

During the record flood of Jan. 4, 1982, the concrete channel overtopped its banks and flooded adjacent properties, even though the flow was well below design capacity. Measurements of peak flood elevations and of flow made it possible to reproduce the hydraulics of the flow by using HEC-2. Instead of Manning's roughness of 0.014, the actual roughness was at least 0.03.

After another failure during a smaller flood in 1986, the Corps estimated that much of the increase in roughness was due to the resistance effect of sediment bed forms moving down the channel. This caused the channel to flow subcritically instead of supercritically, causing flood elevations about 6 ft higher than predicted. During the flood, large amounts of gravel and boulders were conveyed through the channel and deposited in the delta at the channel mouth.

Fluvial geomorphologists had previously recognized the effect of increasing bed-load sediment size on increasing Manning's roughness values in natural channels, as well as the increase in the size of the bed load moved by larger flood flows. But the Corte Madera Creek project was designed with the flawed assumption that clear-water flow without sediment occurs during large floods. Unfortunately, this mistaken idea is still used in the design of many flood-control projects.

---

*Philip B. Williams, M.ASCE, is president of Philip Williams & Associates, Ltd., a San Francisco-based hydrology consulting firm.*

**LEAGUE of WOMEN VOTERS**

LOS ALTOS – MOUNTAIN VIEW AREA
*Hillview Community Center*
97 Hillview Avenue Los Altos, Ca 94022 (415) 941-4846

Handled 'd
1/26 BHG w/a)
SHW
JME
ERS
SMW

Janu

RECEIVED
JAN 26 1990

Dr. Bernie Goldner, Environmental Specialist
Project Development Branch
Santa Clara Valley Water District
5750 Almaden Expressway, San Jose

Dear Dr. Goldner:

In reviewing the Draft Environmental Impact Report for Adobe Creek Channel Improvements from Charleston Road to El Camino Real, there are impacts to the environment that we feel have not been thoroughly assessed.

The League of Women Voters supports measures which promote the management and development of water resources in ways that are beneficial to the environment with emphasis on conservation and high standards of water quality that are appropriate for the intended use. I believe this is very close to your own mandate as a water conservation and flood control district.

The League also supports measures that reserve stream flows for protection of fish and wildlife habitat and other instream uses.

As stated in your environmental assessments, construction of the project would result in the removal of trees and other vegetation located above the creek channel and in adjacent backyards, and will result in a loss or disturbance of a nesting area for resident or migrating birds. The only mitigation offered, is monetary compensation to the property owners.

A natural riparian greenbelt is a resource to an entire community as well as providing the vital link in the habitat of birds, fish and land animals. This project should still maintain the viability of fish migration upstream in a low flow channel with enough shade protection to preserve a viable water temperature.

Ideally, some continuity of greenery would be maintained on at least one bank. If this is not possible, then mitigation might provide substitute habitat. The conversion of your staging area to a streamside park would provide one oasis of greenery, but box culvert plantings should also be considered.

The project will result in an impact upon the quality and quantity of existing recreational opportunities, as stated in your initial study, and there is no mitigation mentioned in this area. Scout troops did hike from the baylands to Los Altos and Los Altos Hills at one time.

In the area of water quality, the removal of marsh grasses and sediments which have a cleansing effect on water should be noted. Mitigation might encompass a review of non-point source storm drain outfalls to the creek and methods to screen out pollutants.

These sources of routine point and non-point pollution, such as the stormwater runoff from extensive parking areas as in the San Antonio Shopping Center, should be incorporated, ideally, into the flood control project at this time.

42

LEAGUE of WOMEN VOTERS

LOS ALTOS – MOUNTAIN VIEW AREA
*Hillview Community Center*
97 Hillview Avenue Los Altos, Ca 94022 (415) 941-4846

The League of Women Voters of the Los Altos - Mountain View Area noted, when this environmental study was initiated a year ago, that according to the guidelines set forth by the California Environmental Quality Act, the entire flood control project that is envisioned for Adobe Creek should be represented in the EIR.

As a phased project with significant environmental effect, the Lead Agency shall prepare a single EIR for the ultimate project as described in Section 15168. Scoping and cumulative impacts are inherent in a flood control project that extends from the Bay to the mountains, and therefore the full program EIR we feel is mandated under CEQA guidelines.

As two thirds of the watershed of Adobe Creek is in mountainous land that is to a large extent in protected open space, and as the creek travels through conservation easements and parks and quiet suburban neighborhoods, ultimately flowing out to the Palo Alto Baylands wildlife preserve, the conservation of natural resources along this creek is of paramount importance.

The League supports positions which encourage offstream storage, but without considering the benefit of any such diversion and the attendant cost of land acquisition as it affects all the residents along the length of Adobe Creek, the cost-benefit ratio suffers if it is analysed only in relation to this one stretch from Charleston to El Camino Real.

Sound flood control practices should encompass all possible aspects of water conservation and the preservation of water quality, but without losing sight of the requirements of fish and wildlife and recreation.

Sincerely,

Susan Foden

Susan Foden, Acting President

TRG BHG w/a
SNW
JMF
RRS
SMW

January 26, 1990

R JAN 26 1990 D

Dr. Bernie Goldner, Environmental Specialist
Project Development Branch
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, California 95118

Dear Dr. Goldner:

In reviewing the Draft Environmental Impact Report for Adobe Creek Channel Improvements, Charleston Road to El Camino Real, Project #1010, there are a number of concerns which I find have not been adequately addressed.

Primarily, it does not present the support documentation in regards to management of the watershed, and the causes of the flooding that has taken place over the past ten years in the upstream segments of Adobe Creek.

Congress now requires that all federally funded flood control efforts consider acquiring watershed property before proposing more costly construction. The concept is that by obtaining restrictive easements, or easements to flood, that the land is preserved in a natural state that benefits all concerned. And that in Boston, has cost one tenth of what traditional construction would have cost, to flood proof the downtown Charles River area.

Wetlands and floodplains have historically reduced soil loss and excessive runoff. Creeks and streams retained in their natural state maintain water quality, wildlife diversity, aesthetic value and recreational opportunities.

As the upper 2200 feet in elevation of this watershed of Adobe Creek is largely in conservation as permanent open space, it would seem that the major portion of this acquisition has already been accomplished, by the donation of the Duveneck family of the Hidden Villa Ranch, and by the land acquisition of the MidPeninsula Open Space District.

CEQA guidelines also instruct that an environmental review should encompass all phases of a project, "The Program EIR can:

(1) Provide an occasion for a more exhaustive consideration of effects and alternatives than would be practical in an EIR on an individual action,
(2) Ensure consideration of cumulative impacts that might be slighted in a case-by-case analysis,
(3) Avoid duplicative reconsideration of basic policy considerations,
(4) Allow the Lead Agency to consider broad policy alternatives and program wide mitigation measures at an early time when the agency has greater flexibility to deal with basic problems or cumulative impacts, and
(5) Allow reduction in paperwork. " Section 15168

In light of these guidelines it seems mandatory at this time to seriously review the options for upstream retention and preservation of floodplains, and conservation setbacks, if they will, in any way, lessen or mitigate peak flows from the 100 year event or flood.

15

The only suggested options that appear viable at this time are the lower pasture of the Hidden Villa preserve and the Los Altos Hills open space 8 acre parcel at #280 and O'Keefe. Both these properties offer some flood control capability and both have value for wildlife and aesthetic preservation and recreational opportunities. Both need purchase of easements to flood. Exhibit A enclosed.

Some channel improvement is needed between the Hidden Villa entrance road bridge and the 11 acre lower pasture and perhaps part of the flood easement cost might be in payment for these improvements. Ideally the pasture could continue in recreational use and the flood easement would only be triggered under peak flow conditions. A one purpose use as a reservoir is not my suggestion.

The additional location at #280 would entail the purchase of flood easements, if not the property itself as permanent open space, of the old Schilling land that runs adjacent to the Los Altos Hills open space parcel. This, again ideally, would remain as recreational riding land and only be bermed to detain peak flows from Adobe Creek, that would drain gradually at the Purissima and O'Keefe end. Percolation might be feasible here, see attached exhibit B.

A third capability for retention might be on the Los Altos Hills Byrne Park preserve which encompasses 60 acres of watershed.

The other locations mentioned, Foothill College fields, and the low bowl adjacent to Foothill Expressway will flood naturally under peak flow conditions and look to remain in open space. The same natural flooding will occur on Adobe between O'Keefe and Edith along the conservation easements and parks.

Secondly, the subject of water quality is not stressed sufficiently. The planting of grasses and willow wattles in the buffer areas around the large paved parking lots at Foothill College would be a mitigation water quality measure of some merit. In this segment from Charleston Road to El Camino there is the outfall from the San Antonio Shopping Center, I believe, and some water quality non-point source pollution mitigation should be offered.

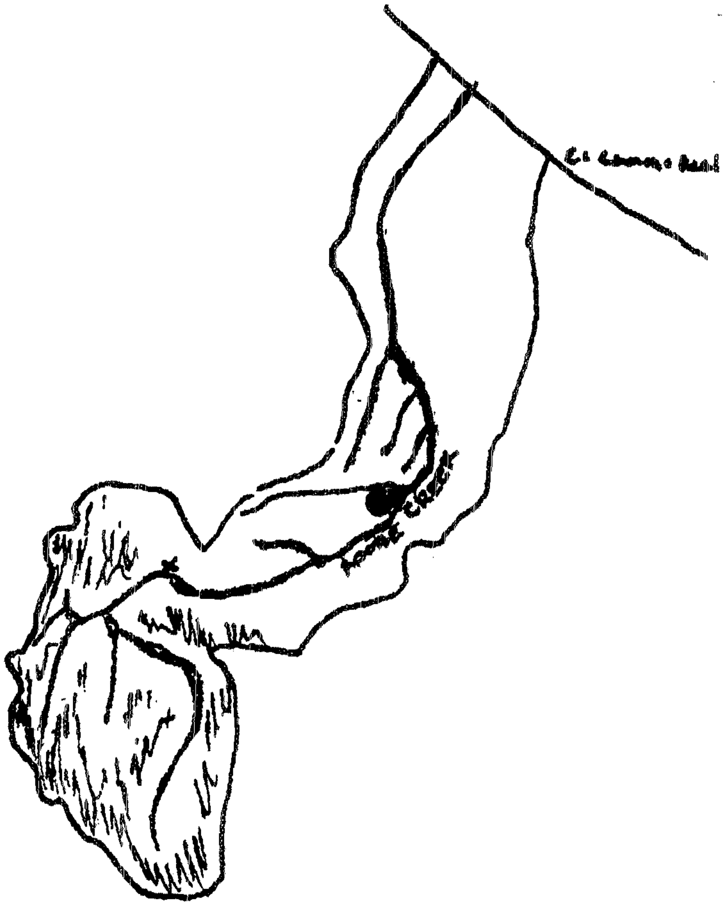
Under peak flow conditions do the street drains empty into Adobe?

Thirdly, there is no mention of the loss of continuity in the riparian cover, which is a loss for wildlife and for the aesthetic and recreational appreciation of humans. Nor is the low flow fish channel assured as a mitigation measure, and this needs shade.

Lastly there is no mitigation suggested for the conversion of a public asset, a trapezoidal channel with ivy has some appeal, to a bleak cement box culvert that poses a hazard for humans and animals alike. The height and steepness of the 10 foot wall make it impossible to extricate oneself from even a low and slow moving stream. Along with fish ladders, how about a few human ladders.

Sincerely, Libby Lucas

Libby Lucas
174 Yerba Santa Ave, Los Altos CA 94022

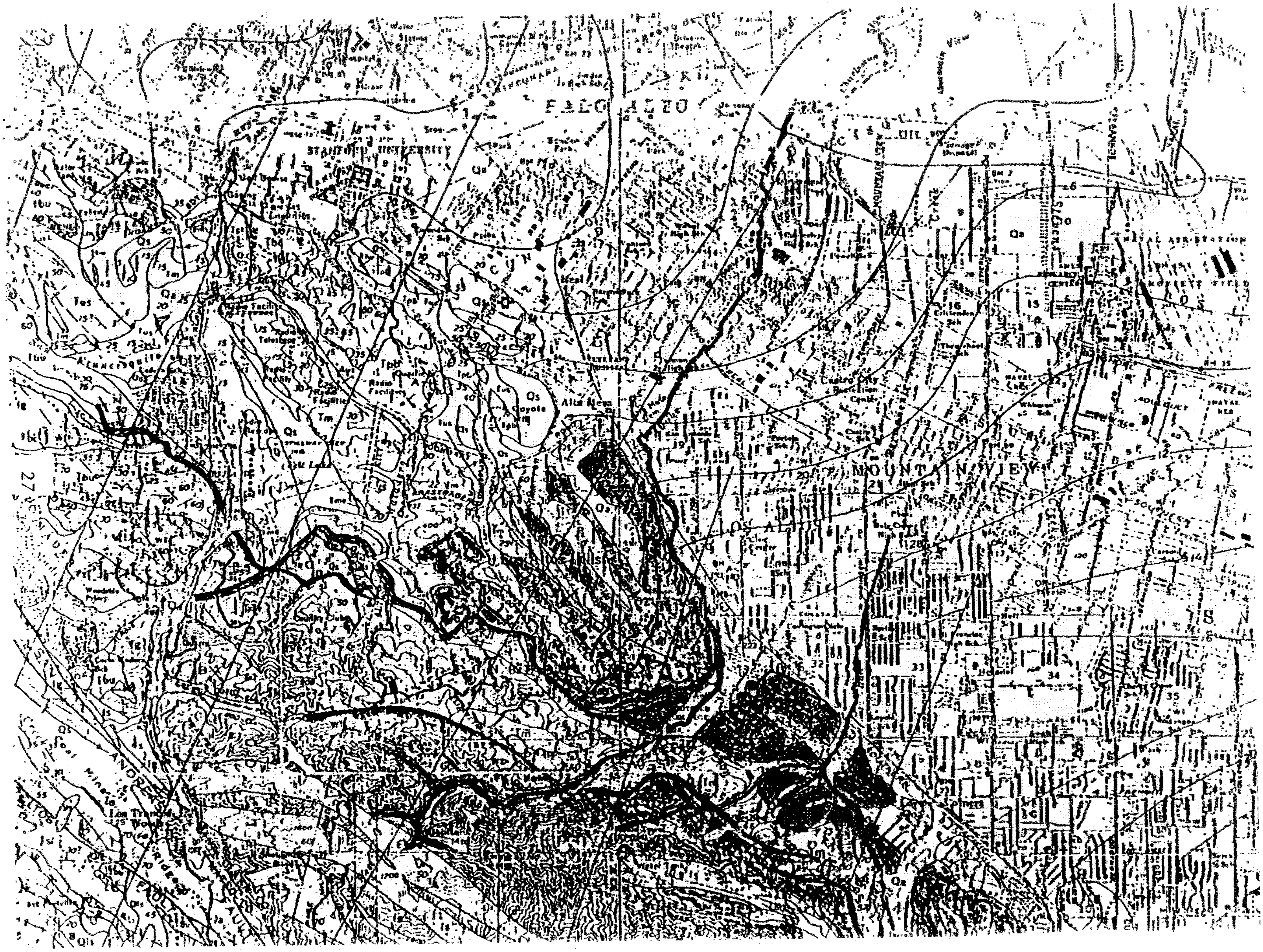


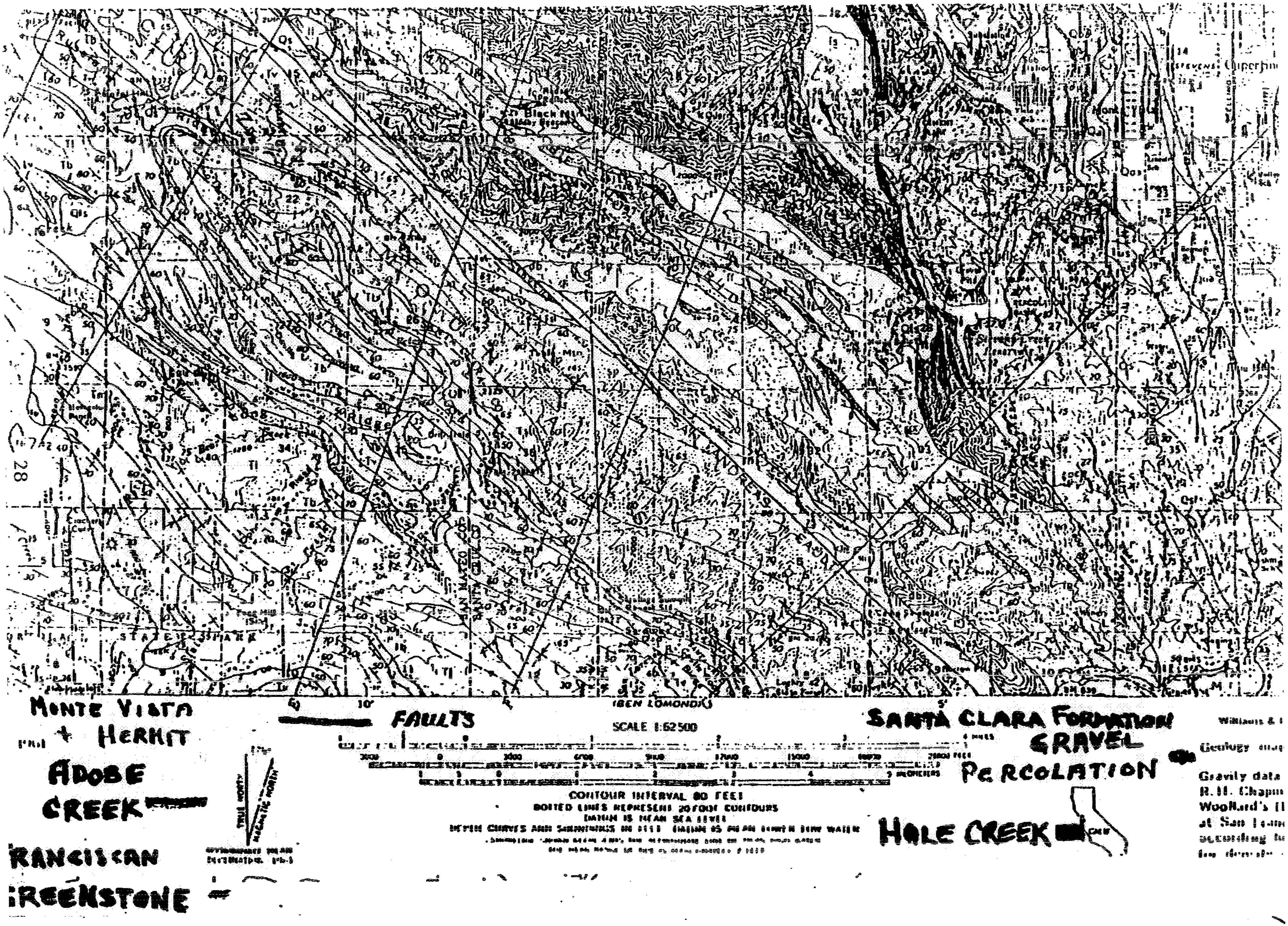
ADOBE CREEK BASIN
AREA 11 sq. mi.

☐ = OPEN SPACE - CONSERVATION

X = LOWER PASTURE - DUVENECK
HYDRAULIC CONTROL POINT

● = CONFLUENCE AT O'KEEFE


PALO ALTO
STANFORD UNIVERSITY
Qs
Tm
Coyote Hill
Alta Mesa
Radio Facilities
MOUNTAIN VIEW
LOS ALTOS
NAVAL AIR STATION
Castro City
Los Altos Hills
Woodside Priory
SAN ANDREAS FAULT
27



MONTE VISTA + HERMIT
ADOBE CREEK
RANCISCAN GREENSTONE
FAULTS
SANTA CLARA FORMATION GRAVEL
PERCOLATION
HOLE CREEK
BEN LOMOND
10'
5'
28
SCALE 1:62500
CONTOUR INTERVAL 80 FEET
DOTTED LINES REPRESENT 20 FOOT CONTOURS
DATUM IS MEAN SEA LEVEL
TRUE NORTH
MAGNETIC NORTH
Williams &
Geology
Gravity data
R.H. Chap
Woollard's
at San
according
Black Mtn
Ridge
STATE PARK

EXHIBIT B

# SECTION V

# MINUTES FROM THE PUBLIC HEARING

# MINUTES
# SANTA CLARA VALLEY WATER DISTRICT
# BOARD OF DIRECTORS MEETING
January 18, 1990

RECEIVED
MAR 05 1990
DAVID J. POWERS & ASSOC.

(Paragraph numbers coincide with agenda item numbers)

An adjourned meeting of the Board of Directors of Santa Clara Valley Water District was held at Room H-1, 4000 Middlefield Road (formerly Cubberly High School), Palo Alto, California, at 7:30 p.m. on January 18, 1990. ADJ MTG

The purpose of the meeting was to conduct a Public Hearing on the Draft Environmental Impact Report (EIR) for the proposed flood control project on Adobe Creek - Charleston Road to El Camino Real, Project No. 1010. PUBLIC HRG

1. Board members in attendance were Directors J. Donohue, P. T. Ferraro, R. W. Gross, J. Judge, J. J. Lenihan, J. Pandit, and S. Sanchez, Chairman presiding, constituting a quorum of the Board.

Staff members in attendance were Ronald R. Esau, James M. Fiedler, Bernard H. Goldner, David Hook, Susan A. Pino, Robert R. Smith and Stanley N. Williams.

Chairman Sanchez welcomed the public and stated that during the Hearing the Board would receive comments on the Draft Environmental Impact Report (EIR) for the proposed flood control project on Adobe Creek. Chairman Sanchez said that no decision on the project would be made at this Hearing. Several public meetings and plan reviews have been held in the community to discuss the flood problems, alternative solutions and their environmental impacts, and to describe the recommended project. As a result of the public input, revisions and modifications were made to the project. District staff believes that the proposed project has minimized, to the extent possible, impacts to vegetation, existing structures and adjacent property owners. The Draft EIR has been out for review since October 1989. Oral statements and additional written comments will be accepted at this Hearing, and written comments will be accepted through January 26, 1990. The Board will make a decision whether to proceed with the project after that date.

2. Chairman Sanchez opened the Public Hearing and appointed Mr. Ronald R. Esau, General Manager, as Hearing Officer. PUBLIC HRG OPEN

Mr. Esau welcomed the attendees and explained that staff would describe the proposed construction project in detail including the District's assessment of all of the environmental impacts. After the staff presentation, written comments will be entered into the record. The Hearing will then be open for oral comments from representatives present from public agencies then for oral comments from anyone present who wished to make such comments. Staff will fully respond in the final report on this project to all of the issues raised at the Hearing or that have been submitted in writing. Staff will be available after the Hearing to respond to individual questions.

Mr. Robert R. Smith, Assistant General Manager, indicated that there has been a series of public meetings in the community which led to the formation of a community technical committee. The committee worked very closely with District staff through the summer. On behalf of the staff, Mr. Smith thanked the committee members who participated.

Mr. Smith reviewed the background of the project. He then introduced Mr. James M. Fiedler, Division Engineer, Flood Control Design Division, who explained the proposed project in detail.

Mr. Fiedler pointed out plans and profiles, which were posted on the walls, depicting the proposed project and also pointed out a map illustrating the flooding that could occur from a 100-year flood on the Adobe Creek watershed. He indicated that the focus of this hearing is the impacts associated with the channel construction of a new U-frame channel between Charleston Road and 800 feet upstream of the Southern Pacific Railroad Crossing.

Using an overhead projector, Mr. Fiedler reviewed the need for the project, the planning process involved, downstream construction, the project evaluation process, alternative evaluation process, project alternatives evaluation, proposed project, construction impacts and project schedule. Mr. Fiedler summarized the project features. He also indicated that pre- and post-construction surveys of the properties will be done by the District or the contractor to ascertain the existing conditions, existing structures, and any features that may be susceptible to damage during construction.

Mr. Fiedler indicated it is anticipated the Board will certify the Final EIR in late February and Phase IV of the design project between Charleston Road and Alma Street will be advertised in April 1990 with construction beginning in the summer of 1990 and completed by summer 1991. Construction of Phase V is anticipated in the summer of 1991 concluding in the summer of 1992. Mr. Fiedler presented slides showing the existing channel in its current conditions and slides of the downstream construction to illustrate the construction activities involved.

Dr. Bernard H. Goldner, Environmental Specialist, reported that the EIR was prepared under contract to the District by David Powers and Associates, San Jose. The Project Manager, Ms. Leianne Humble, reviewed the environmental impacts and mitigation measures of the project. She explained that the intent of the EIR was to accomplish two things: 1) to describe the project impacts clearly and set forth mitigation measures to reduce these impacts and 2) to examine a range of feasible alternatives and determine whether those alternatives could reduce the environmental impacts of the proposed project. In analyzing the alternatives, the short-term construction and the long-term impacts of each alternative were studied and compared to the proposed project, which are summarized in Table 5 of the EIR.

Using an overhead projector, Ms. Humble highlighted the major impacts of each of the alternatives and summarized the impacts from the project which were identified in the EIR. All of these impacts could be partially reduced, although the visual impacts and some construction impacts cannot be reduced to insignificant levels.

Mr. Esau reviewed the written comments received relative to the project.

A letter dated January 2, 1990 was received from Mr. Wade Greene, District CEQA Coordinator, Caltrans District 4, San Francisco, who indicates he would like the District to look at the impacts of this project on Caltrain rail service. Mr. Esau stated it is his

LTR FROM
W GREENE
CALTRANS

understanding from staff that there will not be any significant impact on the Caltrain rail service but the question will be addressed in the final report.

A letter dated January 9, 1990 has been received from the State Department of Fish and Game raising questions concerning fish and game mitigation issues and discussing items that perhaps had not been adequately addressed.

LTR FROM
DEPT F&G

Mr. Esau invited representatives of public agencies or other organizations to address the Board. There was no one present from any public agency who wished to speak.

Mr. Bob Moss, President of the Barron Park Association, addressed the Board. Mr. Moss thanked the staff and the Board for their work with the neighborhood. He addressed some points of the EIR which he found to be inadequate and said he felt those points should be addressed and remedied. Mr. Moss' first concern related to the removal of mature trees and vegetation, which he considers to be a very significant impact. On page 66 the last impact lists the effects of vegetation and wildlife habitat resulting from removal of existing trees as not significant. Mr. Moss said he did not see the logic in that since he believes removal of the trees will have a significant impact both biologically and aesthetically. Mr. Moss stated he feels that vegetation could be planted along the walls to replace plants which were removed and most of the trees could be replanted. Mr. Moss also commented regarding the general methodology of the hydrology. He said he would opt for a lower wall with less flood capacity and instead of having so much freeboard, have freeboard that is a little less excessive.

APPEAR
B MOSS
BARRON PARK
ASSOC

Mr. Smith stated the District feels strongly about its hydrology method and any reduction leaves the District open for challenge from the other side of the professional community and the federal flood insurance program.

Mr. Smith also responded that Mr. Moss' comments regarding the environmental impacts are well taken and will be responded to in the Final EIR. Dr. Goldner explained that the channel does not represent a natural riparian habitat. It is a manmade channel bordered largely by landscape ornamental trees, and the District does not agree that there will be a significant loss of riparian habitat.

Mr. Esau invited individual homeowners and citizens to address the Board.

Mr. R. A. Jensen, 356 Monroe Drive, Palo Alto, addressed the Board. He questioned why people living west of Alma Street and west of the railroad tracks, where it appears there would be no improvement, were noticed to attend these meetings. He said he thought it was because of the ramp at Miller Avenue but no mention has been made of the ramp and that is the only reason he was at the Hearing. He also questioned whether any attention has been given to consideration of the fact that there may be alternatives that are more expensive such as the idea of storage in the Hidden Villa which would not require adding on six-foot walls downstream.

APPEAR
R A JENSEN
PALO ALTO

Mr. Smith responded regarding the activities west of Alma Street. He commented that in addition to the ramp at Miller Avenue there are also people subject to flooding west of Alma because of the plug at the railroad culvert. The District has tried to notify everybody in the vicinity of the creek and in the floodplain because there are people that will be subject to flooding upstream of Alma and downstream of Alma if this particular project is not constructed.

Mr. Fiedler commented that the Hidden Villa site would reduce the amount of the flow in the creek so that there would be about 1500 cfs flowing downstream from the Hidden Villa location. The capacity of the existing channel is only about 1100 cfs and there would still be floodwall requirements in this stretch of the channel that would require vegetation removal. The price of the Hidden Villa is $35 million to $40 million and it would be up to the Board to determine which alternative should be chosen should the staff recommendation not be followed. Mr. Fiedler also commented that a great deal of effort was expended over the last year and a half with the public to minimize the wall heights. Many of the residents have redwood fences along their back yards and the wall heights will not be observable above the redwood fence. The wall height varies from two and a half to five feet.

Director Gross asked if the Hidden Villa could be used for a reservoir and questioned whether it could it be used for recreational purposes to mitigate some of the impacts of wildlife for the future.

Mr. David Hook, Senior Civil Engineer, responded that the Hidden Villa site is currently part of an open space district facility, and the District would be buying or condemning approximately 70 acres and taking what is currently a pleasant area with numerous trees and habitat value and would be clearing out vegetation and making a significant impact on the area. Periodic maintenance activities would be required to remove a good deal of vegetation to keep the capacity up. The District felt there would be an enormous impact on the community and the surrounding area.

Mr. Franz Wagner, 233 Creekside Drive, Palo Alto, representing the Citizens Liaison Group, Greenmeadow Park, addressed the Board. He said he has a chain link fence and putting up any type of wall is highly objectionable to him.

APPEAR
F WAGNER
CITIZENS
LIAISON GROUI

Mr. Wagner read a statement by Mr. John Berwald, who could not be present, stating some of Mr. Berwald's concerns. Mr. Berwald referred to a resolution by the City of Palo Alto in December 1966 regarding the watershed and the upstream area and the requirements for mitigating the need of having an increased amount of flood control downstream because of paving and other improvements to that land. Mr. Berwald also questioned why developments are allowed to encroach so closely to the natural waterways and expressed concern regarding the high walls and the raising of the foot bridge. Mr. Berwald also expressed concern regarding any claims that may be made for damages caused by construction and the environmental effects of the project.

STMT OF
J BERWALD

Mr. Wagner stated his concern with the entire project is in the assumptions used for the project. He still has a question in his own mind whether those assumptions are correct. Mr. Wagner said he believes the proposed alternative literally puts this reach and the people along it in harm's way, where before they were not. He understands the need to help the rest of the people around this creek and around the rest of the flood district resolve the problem.

Mr. Smith commented regarding the hydrology. He said staff has prepared a fairly detailed report for the technical committee which was presented last May when considerable time was spent discussing the assumptions with the District's hydrologist. Mr. Smith indicated the assumptions are totally consistent with in-County practices and with State and national practices with regard to the deterministic hydrology for design of flood control facilities.

Mr. Smith said he agrees with the harm's way issue. As a result of the culvert restrictions at Alma and the railroad, flood waters in the existing channel, at least to the point of overtopping the creek downstream, are currently nonexistent. However, that has put people upstream of Alma Street at jeopardy and the flows that break out upstream of Alma eventually find their way over the railroad and down into the areas in and around the Greenmeadow area. Mr. Smith said he feels the assumptions made in the hydrology and in the hydraulic design will provide the level of protection that not only satisfies the National Flood Insurance Program, but will provide the area an extremely high degree of flood protection equivalent to what is available today. The wall height has been discussed considerably and, from the standpoint of being faced with eight-to-nine foot wall heights and trying to preserve the original channel, the two and a half to five foot wall height today is a considerable improvement over what was recommended a year ago.

Mr. Fiedler stated that treatment of the wall is not currently included in the EIR. It was an option to treat the wall in some fashion so that it does not have the very structured smooth surface appearance. The District is willing to go to that extent in order to minimize the look. It will not diminish the height by any means but give those that have the chain link fence a more aesthetically pleasing appearance of the wall. Mr. Fiedler also discussed the pre- and post-construction surveys in detail.

Mr. Smith responded to Mr. Berwald's comment regarding claims for damage during construction and explained the District's policy regarding such claims.

Regarding assumptions, Mr. Smith stated that Dr. Joe Francini, who is retired from Stanford University and is currently employed by Nolte and Associates, reviewed the hydraulics with regard to the proposed plan and the assumptions that went into that hydraulic analysis, and Dr. Francini has concurred in those assumptions.

P MORRIS
RE BRIDGE

Mr. Esau read a question submitted by Ms. Pat Morris concerning the bike bridge off Duncan which is now closed due to earthquake damage. The District proposed raising the bridge as part of the project, and the City has contacted the District requesting it include the bridge construction in the set of construction documents so that when the contract is issued one of the items will be for the contractor to replace that existing structure with a new bridge structure.

APPEAR
P MORRIS

Later in the meeting, Ms. Morris commented on radiant heating systems in the homes of residents in the project area. She expressed concern that there might be a lag in time between when damage occurs and when the systems fail. It is her understanding that some of these systems fail because there may be a very small insignificant break in the tubing which might not show the first year but with an excess of oxygen in the water it might begin to rust to the point where it becomes a problem. Mr. Smith responded that the District will make every effort to work with each individual homeowner beyond the project but also should remember that the contractor is not off the hook the minute he leaves the job. To the degree the problem is project related, the homeowners can count on the District to make good on those damages beyond that period.

D FOOTE
RE FOOT BRIDGE

Mr. Esau read a similar question from Ms. Diane Foote regarding the foot/bike bridge on Duncan Creekside who did not understand how the bridge could be lower than the walls of the channel and if it would allow flooding onto Duncan Creekside. She also asked about grading on the ramps leading to and from the bridge.

Mr. Fiedler responded the foot bridge would not induce flooding and would be at an elevation above the wall height. Ramps would be provided on both sides and screening would also be provided along the bridge itself to prevent people from invading the privacy of the residents.

Ms. Libby Lucas, 174 Yerba Santa Avenue, Los Altos, addressed the Board. She expressed concern about the concept of upstream retention/detention. She said she was hoping there would be some way to retain the floodplain areas still left on Upper Adobe Creek. APPEAR L LUCAS

Regarding the letter from the Department of Fish and Game, Ms. Lucas inquired regarding fish capability for coming up low flow channel the way it is now designed.

Ms. Ann Justice, 465 El Capitan, Palo Alto, addressed the Board. She had a number of questions relating to the impact of the project on her property. She said she has a small office at the back of the property and the rear wall of the office coincides with the existing fence. She wanted to know if the office would need to be removed for the construction to take place. Mr. Fiedler responded that it was not anticipated that removal would be necessary. APPEAR A JUSTICE

Ms. Justice stated that another consideration about the office is that even though it may not be removed it may be rendered unusable and asked if they would be compensated if it became necessary to relocate their office to rented space. Mr. Smith responded that those decisions would be made on a case-by-case basis.

Director Ferraro noted that there are no figures in the cost analysis for the right of way. He requested that, in order to give the Board an idea of the full cost of the project, staff develop those figures along with any other contingencies such as relocation and whether or not any damages will be considered under a contingency budget or whether they will be considered as a right of way cost.

Mr. Esau concluded this portion of the meeting.

Chairman Sanchez thanked all the attendees for their interest and indicated staff would remain to answer questions relative to particular properties. The District will continue to receive written comments until January 26. The Board will take action some time after that date.

3. Chairman Sanchez adjourned the meeting at 9:28 p.m. to 9:00 a.m. on January 23, 1990 at 5750 Almaden Expressway, San Jose, California.

/S/ SUSAN A. PINO
Susan A. Pino
Clerk/Board of Directors

Approved: /S/ SIG SANCHEZ

Date: FEB 20 1990

# SECTION VI

# NOLTE AND ASSOCIATES REPORT

San Jose

Hand del'd
8/1-DEH w/a
UMF
IS
HAP
RRT
RRS

August 1, 1989
237-89-00

Mr. David E. Hook, P.E.
Associate Civil Engineer
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, California 95118

Subject: Adobe Creek Phase IV Hydraulic Review

Dear Mr. Hook:

This letter summarizes the results of Nolte and Associates' Review of the District's hydraulic calculations on Adobe Creek Phase IV in Palo Alto. Dr. Joe Franzini, Dr. Jim Wang and Chuck Anderson of our office have reviewed the District's calculations.

Specifically we have reviewed:

a) HEC-2 input and output;

b) the determination of the capacity of the existing non-prismatic channel between Alma Street and Charleston Road; and

c) the water surface profile for the District's "preferred alternative" between Charleston Road and 800 feet upstream of Alma Street.

Results of this review are summarized below. More detailed review calculations are attached to this letter.

## HEC-2 Input/Output

The District's HEC-2 decks appear to correctly model both the existing channel configuration and proposed channel improvements for the "preferred alternative". We have not checked each individual cross-section to corroborate GR Cards; but in general, the HEC-2 input and output appears reasonable.

NOLTE and ASSOCIATES
Engineers / Planners / Surveyors

60 South Market Street, Suite 600, San Jose, CA 95113 Tel. (408) 287-3400 FAX No. (408) 287-6906

## Existing Channel Capacity

Methodology contained in the 1989 Adobe Creek Phase IV Hydraulic Capacity Analysis is quite appropriate for the hydraulic conditions that presently occur in Adobe Creek; that is, where the flow regime moves back and forth between subcritical and supercritical flow.

Eddy loss coefficients of 0.1 for contractions and 0.3 for expansions are valid and substantiated in the literature, including those references cited by the District. A Manning's "n" value of 0.015 for design is also appropriate.

In order to review the District's analysis, we modeled a short reach of the creek between two control points: Station 202+98 to Station 208+52.

We found that breaking the subcritical and supercritical decks into smaller reaches (between controls) does not significantly change the resulting water surface profiles. Running one subcritical deck and one supercritical deck for the entire creek does not compromise the accuracy of the water surface profile. We were curious as to the effect of letting HEC-2 run through 20 trials of energy balance to compute the minimum specific energy (critical depth) as opposed to starting shorter decks at control points.

## Sequent Depths

After calculating sequent depths for our review reach (see attachment), we find that our sequent depths are on the order of two feet less than those calculated by the District. Because of this, as seen on the attached profile comparison sheet (sheet 7), some channel sections with assumed supercritical flow may in reality have subcritical flow. Within our review reach, Stations 204+92 to 207+23 are subcritical rather than supercritical.

The largest change in water surface elevation due to sequent depth recalculation is about three feet in our review reach. This increased flow depth does not overtop the existing channel bank within our reach. However, when sequent depths are recalculated for the entire creek, channel capacity could be reduced if an increase in flow depth causes the existing bank to be overtopped somewhere other than Station 217+11 , where the creek first overtops in the District's analysis.

Superelevation and Cross-waves

Formulas used to calculate superelevation of flow through channel bends for subcritical and supercritical flow are correct and may be found in several hydraulic textbooks including Linsley and Franzini (pp. 260 - 261).[1] In the District's calculations for trapezoidal channels, the channel top width B is given as:

$$B = b + z_1 + z_2$$

rather than:

$$B = b + (z_1 + z_2)\ y$$

where b is the channel bottom width, $z_1$ and $z_2$ are the side slopes and y is flow depth. The magnitude of the change in the water surface profile due to recalculation of superelevation and cross-waves is relatively minor.

Water Surface Profile for Preferred Alternative

Changes in sequent depth and superelevation calculations do not affect the analysis for this water surface profile.

After reviewing HEC-2 input and output, the water surface profile for the District's preferred alternative appears to be correct. Flow is supercritical from Station 210+85 downstream to Station 196+55. We do not know what downstream conditions are, but the District should make sure that there are no downstream controls (the District may already know this). Flow is subcritical from Station 210+85 upstream to Station 229+87 (with one critical section at the Alma Street Bridge), so hydraulic jump formation is not an issue.

Hydraulic performance for the preferred alternative should be more stable than the present configuration.

The District is quite correct in using the conservation of momentum to analyze the effect of a junction with an 84-inch outfall upstream of Alma Street. Using Orange County Flood Control District methodology (conservation of P+M) gives nearly identical results (see attachment sheet 9).

We hope you find these comments useful and wish you the best of luck as you finalize the design of Adobe Creek improvements. Please do not hesitate to call with any questions. It has been our pleasure to work with you on this interesting and challenging project.

Sincerely,

NOLTE and ASSOCIATES

Jim Wang

Jim Wang, PhD., P.E.
Engineering Manager